

**Alternatives for Destruction/Disposal
of Love Canal
Creek and Sewer Sediments**

Prepared by

U.S. Environmental Protection Agency

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SECTION 1

EXECUTIVE SUMMARY

On March 28, 1985, EPA issued a report entitled Love Canal Sewers and Creeks Remedial Alternatives Evaluation and Risk Assessment. That report recommended the removal and interim storage of the dioxin-contaminated sediments found in the Love Canal Emergency Declaration Area (EDA) storm and sanitary sewers and nearby Black and Bergholtz creeks. At that time, there was no alternative considered viable for the final destruction or disposal of the sediments. The design for this interim containment facility is near completion. The approximate volume of sediments to be excavated from the creeks is 15,000 cubic yards (cy). An additional 25,000 cy could be generated during the actual excavation activities (i.e., haul road construction).

This report is an addendum and supplement to the 1985 report. Since that time, EPA has thoroughly investigated the treatment and disposal options available for the dioxin-contaminated sediments from the sewers and creeks. The results of these investigations and findings are summarized in the following report. The options and the process of evaluation are presented here for public review and comment. A brief summary of key elements of the report follows.

SCREENING OF ALTERNATIVES

EPA gathered information on alternatives for the destruction or disposal of the dioxin-contaminated sediments. Alternatives considered included biological, physical, and chemical treatment. In addition to the treatment options, the Agency considered options for disposal of the material both on-site and off-site. The information on these treatment and disposal options was used to screen out alternatives that were not considered feasible, effective, reliable or able to treat the sediments in a timely fashion. During this screening process, EPA considered more than 20 types of technology and treatment processes.

The results of this screening are summarized in Table 3-1. For further details on the technologies which were eliminated, see Appendix A.

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As a result of the screening process described above, three alternatives are considered most feasible, effective and reliable. These alternatives have been evaluated in detail and the results of that evaluation are presented in Section 3. The following is a brief description of each alternative.

ALTERNATIVE 1 - ON-SITE LAND DISPOSAL

This alternative makes use of the recently designed on-site containment facility required for implementation of the 1985 creek remedy. Although that facility was intended to provide only interim storage, it has been designed to meet all the requirements for a state-of-the-art Resource Conservation and Recovery Act (RCRA) disposal facility. The facility would contain leak detection and leachate collection systems as well as a double liner, cap and monitoring system.

To implement this alternative, the sediments would be removed from the creeks and sewers, placed in the storage facility, dewatered and capped in the facility.

This option would eliminate the threat of human exposure to the sediments by containing them in a structure. It has the advantage of making use of a structure already underway, so the time of implementation and cost are relatively small. The disadvantage of this option is that it does not permanently destroy the contaminant of concern, dioxin, in any of the sediments. There are no additional remedial action costs for this alternative beyond the estimated \$13 million cost for implementing the 1985 creek remedy. Operation and maintenance costs are estimated to be approximately \$5,000/year. The remedy would be completed as currently planned (i.e., the containment facility would be closed in 1990).

ALTERNATIVE 2 - ON-SITE THERMAL DESTRUCTION/ON-SITE DISPOSAL

This alternative would make use of both the planned on-site containment facility and an on-site incinerator/thermal destruction unit. To implement this option, the sediments would be removed from the creeks and sewers and placed in the storage facility where they would be dewatered. Those sediments contaminated with an average dioxin concentration greater than 1 part per billion (ppb) would be thermally destroyed and returned to the containment facility for final disposal.

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In order to comply with all "Applicable, Relevant and Appropriate Requirements" (ARARs) of the Superfund Amendments and Reauthorization Act of 1986, and to provide protection of human health and the environment during implementation, the thermal destruction unit would be required to demonstrate that it can achieve 99.9999 percent (six 9's) destruction and removal efficiency (DRE). The material being incinerated/thermally treated would be the organic content of the sediment; the majority of the sediment and associated material is not organic and thus not subject to thermal destruction. The residual sediment that is left after thermal destruction would have virtually no organic material remaining. Under this alternative, this residual material would be disposed of in the facility being constructed on-site. It is anticipated that thermal treatment would destroy or significantly reduce the toxicity of the dioxin-contaminated sediments, and it is anticipated that the residual material would no longer be hazardous.

It is the objective of this alternative to destroy the material contaminated with an average dioxin concentration of greater than 1 ppb. This level is being used because the sediments contaminated to greater than 1 ppb represent the principal threat posed by the sediments. The Centers for Disease Control has indicated that material of greater than 1 ppb in a residential setting is cause for concern. By thermally destroying the material with a concentration of greater than 1 ppb, the toxicity and mobility of the principle threat would be significantly reduced. Because it is likely that more sediment would be excavated then would need thermal destruction under this criteria, the sediments contaminated with dioxin at a concentration of less than 1 ppb would be disposed of in the on-site storage facility along with the residuals from the thermal destruction of the more highly contaminated sediments.

The advantage of this option would be to destroy the toxicity of the dioxin-contaminated sediments which pose the threat to human health and the environment. A disadvantage to this alternative would be the possibility of adverse air emissions during implementation. The thermal destruction unit would be designed to minimize any impacts to human health and the environment during implementation. This alternative would still require the on-site disposal facility for the sediments below the 1 ppb level and the residuals from the thermal destruction process.

This remedy including closure of the containment facility, would be completed by 1993 to 1995. Assuming that about 25,000 cy would require treatment and using \$450 cost per ton for thermal destruction, the total remedial action cost for this alternative is estimated to be about \$26.5 million. This includes \$13 million for implementing the 1985 creek remedy and \$13.5 million for thermal treatment of the sediments. Long-term operation and maintenance costs would be \$5,000/yr.

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**ALTERNATIVE 3 - ON-SITE THERMAL DESTRUCTION/OFF-SITE DISPOSAL
OF RESIDUALS**

This alternative also makes use of both the designed containment facility and an on-site incinerator/thermal destruction unit. In addition, this option would require an off-site disposal facility for the residuals of the thermal destruction. To implement this option, the sediments would be removed from the creeks and sewers, and placed in the containment facility where they would be dewatered. Those sediments contaminated with an average dioxin concentration greater than 1 ppb will be thermally destroyed and disposed in an off-site disposal facility. Because the residual material would be disposed off-site, less material would be disposed in the on-site containment facility.

As stated in Alternative 2, the thermally destroyed sediment would have virtually no organic material and is not anticipated to be hazardous. It is expected to be very similar to other construction debris and eligible for disposal in a RCRA Subtitle D (non-hazardous) facility. Because the material would be disposed of off-site, less material would be disposed of in the on-site disposal facility and could potentially reduce the size of the currently designed disposal facility. However, prior to disposing the material off-site, a thorough representative sampling and analysis of the residuals would have to be conducted to ensure that the material is not hazardous.

As with Alternative 2, discussed previously, this alternative would require that the incinerator/thermal destruction unit meet a six 9's DRE. This alternative is also designed to treat only the sediments contaminated with an average dioxin concentration greater than 1 ppb because those sediments represent the principal threat.

The advantages of this alternative would be the same as for Alternative 2. In addition, the size of the on-site disposal facility could be reduced since the residuals from the thermal destruction process (a majority of the volume) would be disposed of off-site. The disadvantage of this option would be the disruption to the community during the transportation of the residuals to the off-site facility.

This remedy, including closure of the facility, would be completed by 1993 to 1995. The total remedial action cost for the creek remediation and sediment treatment under this alternative is \$28 million. This includes \$13 million for implementing the 1985 creek remedy and \$15 million for treatment of the sediments and transport and disposal of the residuals off-site. Long-term operation and maintenance of the containment facility is estimated to be between \$3,000-\$5,000/yr.

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SECTION 2

INTRODUCTION

This report serves as an addendum to a study prepared by CH2M HILL, entitled Love Canal Sewers and Creeks Remedial Alternatives Evaluation and Risk Assessment of March 1985. The CH2M HILL report evaluated several alternatives for the remediation of contaminated storm sewers, sanitary sewers, and creeks located in the Love Canal Emergency Declaration Area (EDA) (see figure 2.1). The CH2M HILL report and other studies including one prepared by Malcolm Pirnie Inc. (Environmental Information Document (EID) "Site Investigations and Remedial Action Alternatives, Love Canal" October 1983) provided the basis for approval of a Record of Decision (ROD) for the site, which was signed May 6, 1985.

The ROD called for the removal of contaminated sediments from specific stretches of the creeks and sewers (see CURRENT SITE ACTIVITIES AND CONDITIONS) and construction of a temporary berm at the 102nd Street Outfall delta area. Of specific concern was the need to reduce the potential for human exposure to the dioxin found in these sediments.

Since all methods of treating/disposing the sediments required some preparation of the materials such as dewatering or sizing, and since it was possible that a year or more may have been required for proper dewatering of the sediments, it was determined that the sediments should be stored in an interim storage facility located in the EDA. Interim storage in a facility meeting all substantive requirements of applicable environmental statutes was consistent with the determination that no destruction, treatment, or off-site disposal options were viable at the point in time at which CH2M HILL performed their investigation. Therefore, the ROD recommended interim storage of the wastes until such time as a means of final destruction/disposal became both feasible and viable. The estimated cost for excavating the creek sediments and constructing the interim containment facility is \$13 million. The \$13 million is a baseline cost for all of the alternatives under consideration in this report.

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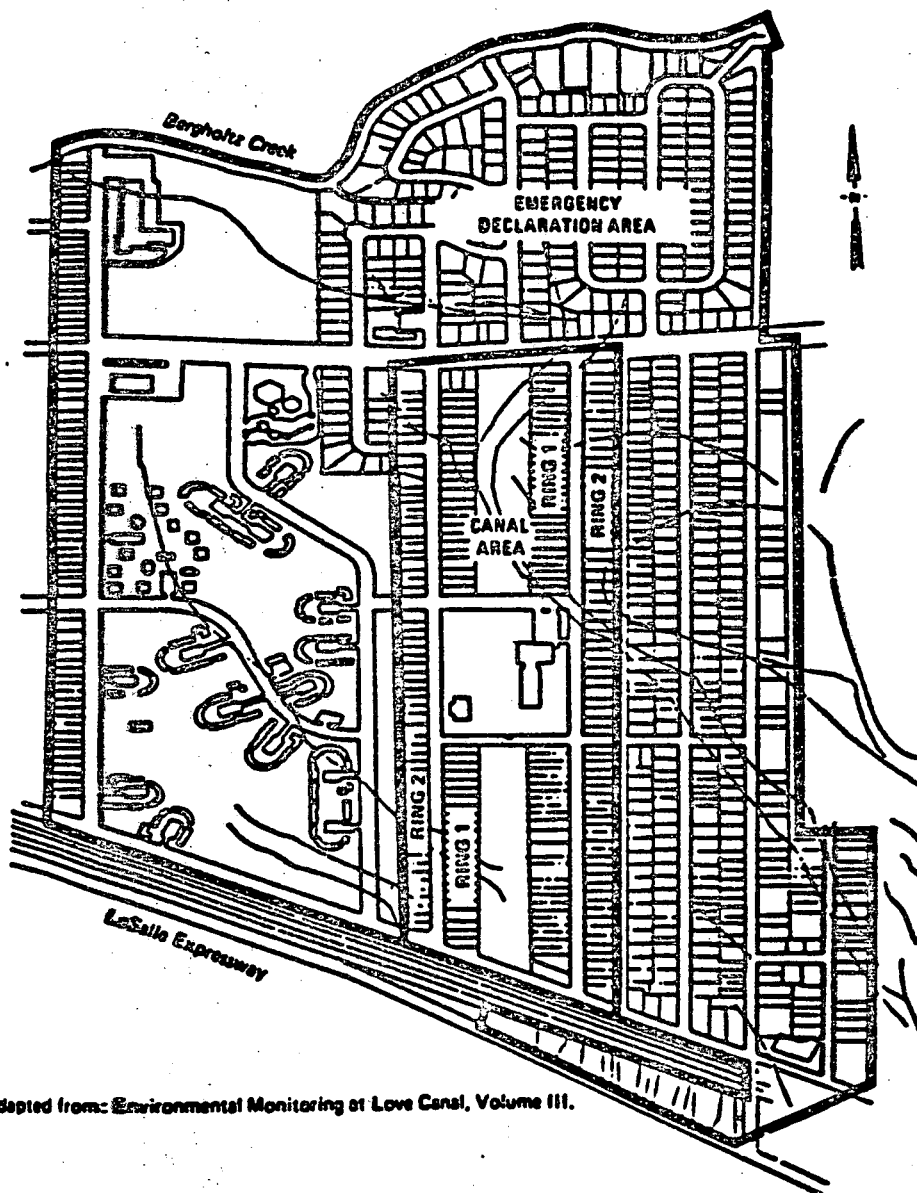
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Adapted from: Environmental Monitoring of Love Canal, Volume III.

Figure 2.1
LOVE CANAL STUDY AREA

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OBJECTIVE

The objective of this report is to develop alternatives for treating/disposing the creek and sewer sediments. Numerous treatment/destruction and disposal technologies were considered in this report (see Appendix A). The technologies were screened according to factors specified in the National Contingency Plan (NCP) 300.68(g) and the viable technologies were combined into three remedial alternatives.

The alternatives are evaluated as they pertain to the selection of a permanent remedy for an estimated 15,000 cubic yards (cy) of dioxin-contaminated creek sediments to be excavated during the creek remediation selected in the May 1985 ROD. An additional 25,000 cy of material may also need to be treated. This material may be generated during the remedial effort (haul roads, construction of the containment facility etc.). In addition, approximately 400-500 cy of dioxin-contaminated sewer sediments will also require treatment/disposal. The evaluation of alternatives reflects a preference for permanent remedies and alternative treatment technologies to the maximum extent practicable as specified in Section 121 of the Superfund Amendments and Reauthorization Act (SARA).

Since this report is an addendum to the CH2M HILL report, frequent reference will be made to that study in an effort to reduce unnecessary duplication of material pertaining to the destruction/disposal of the creek and sewer sediments. The reader is advised to refer to the CH2M HILL report for historical information, as well as an assessment of contamination in the EDA.

SITE LOCATION AND HISTORY

The Love Canal site is located in the southeast corner of the city of Niagara Falls and is approximately one-quarter mile north of the Niagara River. Hooker Chemical and Plastics Corporation (now Occidental Chemical Corporation) disposed of over 21,000 tons of various chemicals (including dioxin-tainted trichlorophenols) into Love Canal between 1942-1952.

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The Love Canal property was sold by Hooker in April 1953 to the City of Niagara Falls Board of Education. During the mid 1950's, home construction accelerated in the area and in 1954 a public school was built adjacent to the middle portion of the Canal. Over the course of the next two decades, contaminated leachate migrated to the surface of the Canal and nearby basement foundations. Contaminants also migrated through area sewers to two nearby creeks.

CURRENT SITE ACTIVITIES AND CONDITIONS

Sewers and Creeks

This addendum focused on the treatment/disposal of the creek and sewer sediments. Approximately 15,000 cy of sediment is scheduled to be removed from Black and Bergholtz creeks in 1988 and/or 1989. An additional 25,000 cy may be generated as a result of the creek cleaning effort. The material might be generated from potentially contaminated haul roads placed in the creek, and from potentially contaminated house debris and soil from the area where ring 2 homes once stood. The house debris and soil needs to be removed in order to build the interim containment facility.

A contractor was procured to clean EDA storm and sanitary sewers which drained from the Love Canal site or which might have been contaminated by drainage from the site. This work was completed in August 1986. Work entailed removal of contaminated sediments by mechanical and hydraulic cleaning, followed by remote television camera inspection to assure that sediments had been removed. Approximately 65,000 linear feet of sewer was cleaned resulting in the removal of approximately 300 cy of sediments. The sewer sediments have been discharged into the dewatering facility where they are currently being stored.

A segment of storm sewer which ran along Frontier Avenue between 97th and 99th Streets at the south end of the Canal has been severed and plugged under a separate contract.

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This work was completed in the spring of 1987. In addition, a small section of EDA storm sewer and a small segment of sanitary sewer outside of the EDA are scheduled to be cleaned in the fall 1987. In total approximately 400-500 cy of sewer sediments including those removed from the inner sewer cleaning conducted in 1983, will be stored on-site.

Design of the creek remedy is 95% complete. Remediation of the creeks is presently scheduled to begin in the fall of 1987 with the construction of the interim containment facility. The actual removal of contaminated creek sediments is expected to take place during the 1988 construction season and will extend into the 1989 construction season. Sediments in Bergholtz Creek will be removed from approximately 150 feet above its confluence with Black Creek to its confluence with Cayuga Creek. Black Creek will be remediated from the 98th Street culverts to its confluence with Bergholtz Creek.

Habitability Study

A study is currently ongoing which will examine the suitability of the EDA for habitation. Criteria have been established by a panel of independent expert scientists to provide guidance for carrying out the study. A peer review of the criteria document was completed in July 1986. The criteria document was revised to address some of the peer review comments. The criteria call for a comparison of the presence of a set of chemicals specific to Love Canal (Love Canal Indicator Chemicals (LCIC)) in the EDA soil and air with the same chemicals, in communities in the Buffalo/Niagara area. These communities are similar sociologically and economically to the EDA.

A two-phased sampling approach is being followed. The first phase included pilot testing of air and soil in the EDA and comparison areas. Pilot study results were used to determine the number of samples to be collected in the full-scale study (second phase) sampling and to provide cost estimates for the full-scale habitability study. The pilot sampling which was conducted in July and August 1986, has also provided information necessary to fine tune the design and methodology for the full-scale study sampling and analysis.

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A report detailing the results of the study and the design of the sampling plan for the full-scale study was recently (March 1987) peer reviewed by an independent panel. The peer review comments are being addressed in the plans for the full-scale study. Soil sampling is expected to begin in September 1987. Air sampling should begin in July 1987.

Analytical results of the full-scale study sampling, as well as results of the statistical comparison of contamination in the EDA and comparison areas, will be made available to the Commissioner of the New York State Department of Health (DOH) in the winter/spring 1988. The Commissioner will then determine whether or not the EDA should be rehabilitated.

It should be noted, that the solution selected for the final treatment/disposal of the creek and sewer sediments will be designed to protect human health and the environment and to allow habitability in the immediate vicinity of the remedial action.

Other Operable Units

Although this addendum focuses solely on remediation of the sewers and creeks, there are a number of other portions of Love Canal currently under various stages of investigation or remediation. These other areas include Love Canal Proper, 93rd Street School, 102nd Street Outfall Delta Area, Cayuga Creek and EDA home maintenance and buyout. More detailed information on these other areas is presented in Appendix B.

An overall time frame for the operable units at Love Canal is presented in Table 2-1. A key concern here is the date of completion of the creek excavation. The excavation is expected to be completed in the 1989 construction season. The sediments will be mechanically excavated, and may have a high moisture content. The sediments may have to be dewatered to a limited extent prior to the closure of the facility, or the possible implementation of treatment/disposal methods to be discussed in this document.

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Table 2-1
LOVE CANAL SUPERFUND PROGRAM
SCHEDULE OF WORK THROUGH 1988

DESCRIPTION	1986	1987	1988
	A S O N D	J P M A M J J A S O N D	J P M A M J J A S O N D
<u>Creeks</u>			
-Design	XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
-Construction		XXXXXXXXXXXXXXXXXXXXXXXXXXXX	
<u>Sewer Cleaning</u>	X	XXX	
<u>Sewer Rerouting</u>		XXX	
<u>93rd Street School</u>			
-RI/FS	XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
-Design		XXXXXXXXXXXXXXXXXXXXXXXXXXXX	
-Construction			XXXXX
<u>Administration Building</u>	XXXXXXXXXX		
<u>Long-Term Monitoring</u>			
-Well Installation			
2nd Phase	XXXX		
-Data Collection	XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
<u>102nd St. Outfall</u>			
<u>Berm</u>			To be determined
-Design			
-Construction			
<u>Habitability Study</u>			
-Dioxin Sampling	XXX	X	
-LCIC Sampling		XXX	
-EPA Final Report			Winter/Spring 1988

Enforcement Status

On December 20, 1979, the U.S. Department of Justice, on behalf of EPA, filed suit against Hooker Chemical and Plastics Corporation pursuant to numerous environmental statutes alleging an imminent and substantial endangerment to health and the environment. New York State filed a lawsuit in State court in April 1980 against Hooker for damages sustained at Love Canal. New York State also joined as a plaintiff in the Federal case. On December 8, 1983, the United States filed a motion for leave to file an amended complaint under Sections 106 and 107 of CERCLA. The legal actions are still pending.

On April 16, 1982, the EPA sent Hooker a CERCLA notice letter. On July 26, 1982, the EPA and State met with Hooker to explain what they planned to do under Superfund. Hooker has refused to assume responsibility for remedial action at Love Canal.

On October 1, 1984, the Department of Justice filed in Federal District Court, a motion for Partial Summary Judgement. This motion concerns Occidental Chemical Corporation's (OCC) liability under CERCLA. In November 1986, the court heard the motion. The court is also considering a motion to bifurcate the trial whereby the issues of liability will be tried separately. The Department of Justice and Department of Law are currently working together to prepare for trial.

COMMUNITY RELATIONS

Community involvement at Love Canal has been extensive. A comprehensive community relations strategy has been developed by the New York State Department of Environmental Conservation (DEC) to keep concerned parties cognizant of CERCLA activities at the site.

The DEC maintains a Love Canal public information office. The office is located in the EDA at 9820 Colvin Boulevard and is open to the public. In addition to this office, the EPA has a public information office in the City of Niagara Falls. The public is also kept informed through

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numerous public meetings. In addition, the Love Canal Technical Review Committee, a committee represented by senior members of the Department of Health and Human Services, DEC, DOH and EPA, meets monthly to discuss the Love Canal Habitability program and related remedial activities.

A public meeting and a workshop were held on March 5, 1985, and March 12, 1985, respectively, to discuss the CH2M HILL draft report (dated March 1, 1985).

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SECTION 3

EVALUATION OF ALTERNATIVES

The alternative identification and screening process was conducted as required by the National Contingency Plan (NCP) and the EPA Interim Guidance on Selection of Remedy (December 24, 1986). Technical, institutional, environmental and cost evaluations of the remedial alternatives were summarized. SARA requires that treatment alternatives and alternative treatment technologies be evaluated to the maximum extent practicable. In addition, treatment alternatives should be developed which significantly reduce the mobility, toxicity, or volume of the waste. These factors were fully considered within the evaluation of the alternatives.

Alternatives for final destruction/disposal of the dioxin-contaminated sediments are evaluated in this report. Treatment alternatives evaluated included biological (e.g. microbial degradation), physical (e.g. in-situ vitrification and thermal destruction), and chemical (e.g. polyethylene glycol dechlorination) methods. Disposal alternatives included transport to an off-site facility and on-site disposal.

All but three alternatives which underwent initial screening were eliminated. Table 3-1 lists the technologies/disposal options which were evaluated and reasons for retaining or rejecting specific technologies/disposal options. A more detailed discussion of the technologies/disposal options which were not retained for further analysis is provided in Appendix A. The technologies which were rejected have not achieved the preferred stage of development for utilization at Love Canal. Several of these screened out technologies could be applied to treatment of dioxin-contaminated soils, however, none have demonstrated the desired destruction and removal efficiencies (DREs) for initial dioxin concentrations in the low part per billion range. In addition, none have resulted in delistable process residues (i.e. certified as non-hazardous). This section provides a detailed evaluation and comparison of the three remaining remedial action alternatives.

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TABLE 3-1

SUMMARY OF INITIAL ALTERNATIVES SCREENING

Location/ Remedial Action	A Status	B Tech. Feas.	C Public Health Concerns	D Anticipated Public Response	E Environmental Concerns	F Other
1. DISPOSAL On-site: Beneath Existing Cap	Eliminated (B, C, D, E)	Not feasible (See F)	Increased exposure potential during re- medial action	Mixed	Short-term remedial action impacts	No volume available in cap below liner; would require excavation of more contaminated material.
Beneath Ex- panded Cap	Eliminated (C,D,E,F)	Potent- ial prob- lems for 40,- 000cy of sed- ment (See F)	Increased exposure potential during remedial action	Mixed	Short-term remedial action impacts	Public is extremely opposed to in cap disposal. In- tegrity of existing cap and containment system could be compromised.
Final Disposal in Currently Designed Con- tainment Facility	To be con- sidered	Feasible	Unchanged exposure potential except during long term maintenance when exposure potential may increase minimally	Mixed	Possible short- term impacts during long term maintenance	Major retrofitting, although not expected for 25 years, could increase operation and maintenance costs. Member Agencies of the Tech- nical Review Committee have agreed that on-site storage of sediments will not impact habitability determinations so long as the sediment storage is consistent with appropriate environmental statutes.
Off-site Disposal	Eliminated (B)	Not feasible (See F)	—	Mixed	—	No off-site facilities are per- mitted to dispose of dioxin- contaminated waste.

TABLE 3-1

SUMMARY OF INITIAL ALTERNATIVES SCREENING
(continued)

Location/ Remedial Action	<u>A</u> Status	<u>B</u> Tech. Feas.	<u>C</u> Public Health Concerns	<u>D</u> Anticipated Public Response	<u>E</u> Environmen- tal Concerns	<u>F</u> Other
2. TREATMENT						
Off-site Thermal Destruction	Eliminated	Not Feasible (see F)	Minimal exposure potential	Acceptable	Short-term remedial action impacts	No off-site facilities per- mitted to treat dioxin- contaminated waste.
Biological Treatment	Eliminated (B)	Not feasible (See F)	—	—	—	Not demonstrated effec- tive on dioxin in sediments.
Chemical Treatment	Eliminated (B)	Not feasible (See F)	—	—	—	Not demonstrated effective on sediments with initial con- centration in the low ppb range.
Physical treatment	Eliminated (B)	Not feasible (See F)	—	—	—	Not demonstrated effec- tive on dioxin in soils.
Commercial Transportable Units	To be Considered	Feasible	Minimal exposure potential	Mixed	Short-and long term remedial action impacts	

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The three alternatives considered are:

1. On-site land disposal.
2. On-site disposal of untreated sediment containing an average dioxin concentration less than 1 ppb;
On-site thermal destruction of sediment containing an average dioxin concentration greater than 1 ppb;
On-site disposal of residuals of thermal destruction;
3. On-site disposal of untreated sediment with an average dioxin concentration less than 1 ppb;
On-site thermal destruction of sediment containing an average dioxin concentration of greater than 1 ppb;
Off-site disposal of thermal treatment residuals (if delisted).

The three alternatives are evaluated in light of the facts that interim storage of the sediment is required prior to implementing any treatment/disposal alternative, and that the 1985 ROD dealt with the evaluation of alternatives for remediating the creeks and sewers. The ROD called for removal of the creek and sewer sediments and interim storage in a containment facility meeting all substantive technical requirements of state and federal regulations for land disposal facilities.

The construction cost for the creek remedy selected in 1985 is approximately \$13 million. Approximately \$4 million will be spent on construction of the interim containment facility. Construction of the facility is scheduled to begin in 1987 and be completed in the 1988 construction season. The remaining \$9 million will be allocated for the actual excavation of the creek sediments in 1988 and/or 1989. Since the sediments will require some degree of dewatering, the facility may not be closed until the construction season following creek sediment removal. In addition \$850,000 has been spent on the design of the creek remedy which is at the 95% completion stage. The alternatives analyzed here deal with treatment/disposal of the sediments as removed and stored in the containment facility (1989).

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The following evaluation factors (based on Section 121 of SARA) were used to conduct the alternative analysis:

- Reduction of existing risks
- Protection of community and workers during remedial actions
- Permanent and significant reduction of mobility, toxicity or volume
- Compliance with applicable or relevant and appropriate requirements
- Time until protection is achieved
- Long term reliability/potential need for replacement
- Magnitude of residual risks/prevention of future exposure to residuals
- Costs for implementing remedial actions
- Costs for operation and maintenance/potential future remedial actions

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ALTERNATIVE 1 - ON-SITE LAND DISPOSAL

Under this alternative, the creek and sewer sediment would undergo final disposal in the interim containment facility as currently designed. The facility, as called for in the ROD is a RCRA facility and is designed to meet the substantive technical requirements of state and federal permitting regulations for permanent land disposal facilities.

No further action aside from that which was specified in the 1985 ROD is required under this alternative.

Reduction of Existing Risks

Dioxin, the contaminant of concern in the creek and sewer sediments, has been found at the low ppb level in the top 12" of creek bed/sediment (highest detected concentration = 46 ppb). No dioxin has been detected in sediments/bed below the one foot mark. Current plans call for removal of the top 18" of creek sediment/bed. Therefore, it is expected that the concentration of dioxin in the stored creek sediment should not be present in concentrations above the low ppb level and may not be above the 1 ppb Centers for Disease Control (CDC) level of concern for dioxin in residential soils. In addition to the 40,000 cy of creek sediments and associated material, approximately 400-500 cy of sewer sediments would be stored in the facility. The average concentration of dioxin in the sewer sediment is expected to be higher than the average concentration of dioxin in the creek sediment. However, the quantity of sewer sediments only represents 1% of the quantity of creek sediment. Dioxin has a very limited solubility in water, is not volatile, and binds tightly to sediment/soil. Therefore, exposure to the sediments, not the leachate generated from dewatering during storage, is of most concern. Human exposure to the sediment during interim storage is not likely.

The stored sediments would continue to contain dioxin and, therefore, would not be as "clean" as material generated from treatment of the sediments. However, this criterion should be examined in light of the concentration and quantity of contaminants in Love Canal proper. Such a

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Such a comparison indicates that the level of isolation is higher for stored sediments than for material in Love Canal proper, since the disposal facility is designed to meet the substantive requirements of RCRA. One need only examine the chemical analyses of the influent to the leachate treatment plant to realize that the sediments are, by far, less contaminated (and therefore pose less of a risk) than the materials deposited in the Love Canal proper.

Protection of Community and Workers During Remedial Action

Since there isn't any additional remedial action associated with this alternative, there aren't any related remediation impacts on the community. However, the disposal facility will be visible to the community and would continue to impact the community in an aesthetic manner. It is important to note that none of the alternatives evaluated here would completely eliminate this aesthetic impact.

Permanent and Significant Reduction of Mobility, Toxicity or Volume

The containment facility is meant to contain the contaminants and therefore prevent migration of contaminants out of the facility (vs. leaving the sediments in the creeks and sewers where the potential for migration would be high). The alternative does not provide a permanent or significant reduction of the toxicity or volume of sediments.

Compliance With Applicable or Relevant and Appropriate Requirements

The dioxin-laden stored sediments will be isolated from the community and will be appropriately managed. The facility is designed to protect human health and the environment.

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The disposal facility will comply with all the relevant requirements of the Resource Conservation and Recovery Act (RCRA) and Title 6, Part 373 of the New York Compilation of Rules and Regulations. Consistent with SARA, the continued effectiveness of the facility would be evaluated every five years to assure continued protection to human health and the environment.

Time Until Protection is Achieved

The creek sediments are expected to be removed from the creeks and in place in the facility during the 1989 construction season. The sediment may require some degree of dewatering prior to closure, such that closure would probably occur in 1990. The sewer sediments will be placed in the facility upon completion of its construction in 1988. It should be noted that this addendum is based on the premise that interim storage will occur, and is necessary prior to implementing any treatment/disposal remedies for the sediments.

Long Term Reliability/Potential Need for Replacement

The containment facility is designed to ensure long-term reliability. As stated above, the design will comply with all substantive technical requirements for RCRA permanent disposal facilities. The facility may eventually require replacement or major repair; however continued maintenance will delay this need.

Magnitude of Residual Risks/Prevention of Future Exposure to Residuals

As stated above, if not treated the sediments may contain an average dioxin concentration above the 1 ppb CDC level of concern for dioxin in residential soils. Since the dioxin is expected to remain bound to the sediment, human contact with the sediment is the exposure pathway of concern. Human contact with the sediment while contained in the facility is not likely and therefore, a residual risk exists but is not highly significant.

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The design of the facility will prevent future exposure to residuals. The facility will be monitored closely and repairs will be made as needed. The facility will be equipped with a leak detection system consisting of perforated drain pipes running to a leak detection sump. The leachate from the leak detection and leachate collection systems will be collected and pumped to the leachate treatment system. Once the facility is closed it will be impermeable to rainwater, thereby minimizing the generation of leachate. The following routine maintenance will be necessary:

- Routine checks of the leak detection system to insure the integrity of the synthetic membranes and to insure that the leachate collection system is working properly,
- Leachate removal and treatment as necessary,
- Scheduled monitoring, and
- Maintenance of the walls and cap of the facility to insure its integrity.

Costs for Implementing Remedial Actions

Since the construction of this facility is already called for in the 1985 ROD, and since no additional remedial action is called for under this alternative, there are no additional remedial action costs. (Note: 1985 ROD creek excavation remedial action is estimated to cost \$13 million, \$4 million of which will be for the containment facility construction.)

Costs for Operation and Maintenance/Potential Future Remedial Action

The operation and maintenance costs for the containment facility were estimated by CH2M Hill to be \$3000/yr of operation for a 20,000 cy facility. It is estimated that it would cost \$5000/yr for operation of a 40,000 cy facility. Replacement or major repair costs may be necessary over the long-term (i.e. 20-40 yrs.).

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ALTERNATIVE 2 - ON-SITE THERMAL DESTRUCTION/ON-SITE DISPOSAL

This alternative addresses treatment of the principal threat posed by the sewer sediments and creek sediments that contain an average dioxin concentration greater than 1 ppb. The alternative combines on-site thermal destruction and on-site disposal. Those sediments above the 1 ppb average would be thermally treated and then disposed in the containment facility; those below would be disposed in the facility without treatment.

As noted, the contaminant of concern in both the creek and sewer sediments is dioxin. Although the majority of samples collected from both the sewers and creeks (in several different sampling events) were non-detect for dioxin at the 1 ppb level, several sewer sediment samples had elevated levels of dioxin with the high concentration of 650 ppb. The highest concentration for the creek sediments was 46 ppb.

A significant quantity of the material to be stored in the facility as a result of the creek remediation is likely to have an average dioxin concentration that is less than the 1 ppb level of concern for dioxin in residential soils. At such levels, the contained creek sediments do not pose a significant threat to human health and the environment. Equally important is the quantity of creek sediments which do contain an average concentration of dioxin above 1 ppb.

The final volume of sewer sediments requiring treatment/disposal is expected to be approximately 400-500 cy. The sewer sediments represent a relatively small amount of waste (1%) when compared to the 40,000 cy of material requiring treatment/disposal as a result of the creek remediation. However, the sewer sediments should have the highest concentration of dioxin.

Since the sediments above the 1 ppb level are the principal threat, on-site thermal treatment of these sediments with a transportable thermal destruction unit (TTDU) would significantly reduce the mobility and toxicity of the waste disposed in the containment facility. As noted in Appendix A, manufacturers of TTUDs either currently have units available or plan to have units available in the near future (see Table A-2).

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At this point in time, it is difficult to accurately estimate the quantity of sediments that contain an average dioxin concentration greater than 1 ppb. For the purposes of this discussion, it will be assumed that approximately 25,000 cy of sediment (approximately two-thirds) would require thermal treatment.

Once the creek and sewer sediments are in the disposal facility, a sampling program would be implemented to further refine the volume of sediments requiring thermal destruction.

From an engineering perspective, it may not be possible to effectively separate all of the sediments expected to be greater than 1 ppb material from the expected to be less than 1 ppb material. This could result in the entire 40,000 cy of material requiring treatment if it contains an average dioxin concentration above 1 ppb.

Reduction of Existing Risks

A thermal destruction unit achieving six 9's DRE should effectively reduce the dioxin contamination in the sediments to well below the 1 ppb CDC level of concern. The unit should be operated in such a manner that the process results in a residual material ("residuals") which can be delisted to a non-hazardous status. Successful delisting of the residues from the thermal treatment of dioxin contaminated soils and liquids at the Denney Farm site (Missouri), has been demonstrated by the EPA mobile incinerator (see Appendix A).

Successful operation of the unit would eliminate the principal threat posed by the sediments (i.e. sediments with an average concentration of dioxin above the CDC level of concern for dioxin in residential soils (1 ppb)). Risks associated with the untreated contained sediment are not expected to be significant. This alternative should provide full protection to human health and the environment.

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Protection of Community and Workers During Remediation

The possibility exists that an on-site thermal destruction unit and/or associated air pollution control equipment, materials handling equipment, or materials pretreatment equipment may generate noise during routine operation. Any such noise would probably not be noticeable except during nighttime operation. Proprietors of TTDUs have indicated a willingness to house or insulate any noisy pieces of equipment or take any other measures necessary to eliminate the generation of noise.

In addition, the potential for dust and particulate generation during materials handling and pretreatment may result in increased community exposure to the materials. Also increasing this potential is the fact that the containment facility itself would not be permanently capped for an extended period of time. The potential for air emissions of products of incomplete combustion also exists. Measures would be taken to ensure that all these potentials are controlled prior to full-scale operation. Workers would be protected through measures outlined in project specific health and safety plans and contractor adherence to Occupational Safety and Health Act (OSHA) regulations.

Under this alternative, the containment facility would remain as a permanent structure and would therefore continue to impact the community aesthetically.

Permanent and Significant Reduction of Mobility, Toxicity or Volume

On-site thermal destruction provides a permanent reduction of the toxicity of the principal threat. Since the average concentration of dioxin in the untreated sediments is expected to be in the low ppb range, (except for sewer sediments) the concentration (and therefore toxicity) of the treated sediments would be reduced to less than 1 ppb.

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The volume of the material would not be reduced to any great degree by the thermal destruction alternative since the creek sediments have a very low organic matter content. Only the volume of highly organic vegetative material overlying the creek bed, and the sewer sediments (which together only represent a small percentage the total quantity of material) would be substantially reduced. The long-term mobility of the contamination would be reduced by thermal destruction in the sense that the materials would be detoxified. However, mobility of contaminants over the short-term would be increased due to air emissions of products of incomplete combustion and increased materials handling. Measures would be taken to assure that these emissions would not pose a significant threat to human health or the environment.

Compliance with Applicable or Relevant and Appropriate Requirements

With the passage of SARA, permits are not required for on-site remedial actions at Superfund sites. Although formal permits are not required, any action must meet the substantive technical requirements of applicable federal and state permit regulations. In order to meet such requirements, the transportable unit would have to undergo waste specific trial or demonstration burns to demonstrate satisfactory destruction of the toxic components of the waste.

In order to operate an on-site thermal destruction unit at the Love Canal site, the substantive technical requirements of the following should be met:

- ° Air Pollution Control Permit Requirements,
- ° Waste Management/Hazardous Waste Thermal Destruction Permit Requirements, and
- ° Requirements for Downgrading or Delisting of Process Residues.

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Of specific importance during trial burn or demonstration burn evaluations are the need to achieve six 9's DRE, and ensure that air emissions of products of incomplete combustion, particulates and acid gas are controlled. If trial burns or demonstration burns were not successful, operation of the unit would not be approved.

As stated earlier, the containment facility is designed to meet the requirements of a RCRA permanent hazardous waste disposal facility and would be maintained and monitored to ensure its integrity. Consistent with SARA, the continued effectiveness of the facility would be evaluated every five years to assure continued protection to human health and the environment.

Time Until Protection Is Achieved

On-site thermal treatment of the sediments would involve transporting and setting up a TTDU on the site to treat the sediments. The sediments would have to be dewatered prior to thermal destruction. It is also likely that the sediments will require some pre-treatment such as screening, crushing, shredding etc., prior to treatment. Prior to full-scale operation, the successful operation of the unit would have to be demonstrated through trial or demonstration burns.

The steps involved in siting a TTDU are outlined in figure 3-1. Each step in the process has an associated range of time required to complete that step. As can be seen from the figure, the time required to site and begin full-scale operation of a unit could be between 32 months and 60 months. It is possible that some of these steps could be performed in parallel. However, it is unlikely that full-scale operation could begin in less than 32 months.

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Figure 3-1

**Transportable Thermal Destruction Unit - Estimated Time Frames
for Events Leading to Start-Up/Full-Scale Operation**

State procurement of design con- tractor* 6 months - 10 months
Performance of RD 9 months - 1 year
State procurement of a vendor for RA 6 months - 1 year
Approval to trial burn (TB) or demon- stration burn 4 months - 1 year
Mobilization 2-3 months
Trial burn/ demonstration burn 1-4 months
Review TB/demonstra- tion burn results. Petition to delist process residues. Issue full approval or permit to operate 4-7 months
Start-up Full-Scale Operation

- * Design contractor would perform necessary studies/tests to adequately define waste characteristics and prepare performance based bid specifications used for the selection of a vendor, as well as establish criteria for evaluating different vendor technologies.

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It is envisioned that the first element, the procurement of a design contractor for preparation of bid specifications for treatment of the wastes, could begin immediately. The procurement of a contractor to treat the wastes could be carried out upon the completion of the design phase.

It is not likely that trial burns would begin until after the summer of 1989. At best, the initiation of full-scale operation could probably come close to coinciding with the completion of sediment dewatering in 1990. Using the longer end of the range, full-scale operation would not begin until fall of 1992. After full-scale operation is initiated, the treatment of the wastes under Alternative 2 could be conducted in about two years if a 2.5 ton per hour unit were operated 24 hours a day. This would put the completion date for treatment at 1992 to 1994. Under this alternative the residue would be placed back in the containment facility and the facility would have to be capped and closed. The closure of the facility would place the final completion date at 1993 to 1995.

It should be noted that the full-scale operation of transportable units at hazardous waste sites has been limited. When units have been operated, extended periods of downtime have been the norm. It is likely that operation of a unit at Love Canal would also result in some extended downtime periods. The downtime periods would delay completion of thermal destruction of wastes and ultimately closure of the containment facility.

The time required for actual on-site thermal destruction could potentially be decreased by using two or more transportable units. It is unlikely that two or more units would be used at the site, due to space limitations, cost considerations and the need to approve operation of two units rather than one. Use of a larger capacity unit (e.g. a 5 ton per hour unit) could also reduce the time required to process the sediments.

Long Term Reliability/Potential Need for Replacement

Since the toxicity of the materials which pose the principal threat would be reduced to below the CDC level of concern for dioxin in residential soils, (and therefore the average dioxin concentration of all materials in the facility would be less than 1 ppb) this alternative provides a high degree of long-term reliability.

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The material would not contain average dioxin concentrations of above 1 ppb, so the need for long term replacement would not be as great as it would be if the average concentration were above 1 ppb. Routine maintenance and repairs should delay the need for replacement into the distant future.

Magnitude of Residual Risks/Prevention of Future Exposure to Residuals

As stated above the residual risks associated with containment of sediments and residuals from sediment treatment would be insignificant. Measures taken to prevent future exposure to residuals would be identical to those identified for the containment of untreated sediment. (See Alternative 1).

Costs for Implementing Remedial Action

Table 3-2 provides cost/ton estimates for on-site thermal destruction of the sediments. The estimates were provided by proprietors of transportable thermal destruction units. The estimates are for the introduction of the waste to the unit and removal of residuals from the unit. It should be noted that the estimates do not include site preparation, waste preparation etc., nor do estimates include trial burn expenses. Trial burn expenses are estimated to be \$500,000. Materials pretreatment (sizing, shredding, crushing) is estimated to add approximately 10% to the processing costs.

An estimated cost of \$450/cy for on-site thermal destruction of 25,000 cy was determined using the median value provided in Table 3-2; CH2M Hill's estimate of a percent moisture content of 50%; and a bulk density representative of moisture free sediments equal to 1.33 (g/ml). These assumptions result in a conversion factor of 1.68 tons sediment per cy sediment and a total cost of approximately \$11.3 million to treat 25,000 cy of sediment. Applying the same assumptions and using the cost range in Table 3-2, it can be seen that there is a very large range in total cost for on-site thermal destruction. The costs range from \$6.0 million to \$16.1 million for processing the materials from the front end to back end of the TDU.

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TABLE 3-2
TRANSPORTABLE THERMAL DESTRUCTION UNIT
TOTAL COST/TON (\$/TON)

Based on a Total of 25,000-40,000 Cubic Yards of Sediment

% Moisture

20(1)	Range	150-450
	Median	200
	Mean	230
50(2)	Range	150-400
	Median	260
	Mean	260
70(3)	Range	170-350
	Median/Mean	260

- (1) Costs at 20% moisture were obtained from responses to questionnaires received from five thermal destruction unit designers and/or manufacturers.
- (2) Costs at 50% moisture were obtained from six designers and/or manufacturers.
- (3) Costs at 70% moisture were obtained from two designers/manufacturers.

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Using the median value the total costs for treating the waste is estimated to be \$13 million. The performance of tests and studies necessary for the preparation of bid specifications is estimated to be approximately \$500,000 bringing the total treatment estimate to \$13.5 million. Therefore, the complete remedial cost for excavation of the creeks (1985 ROD) and treatment of the sediments would be approximately \$26.5 million.

As noted earlier, it may be very difficult from an engineering perspective to selectively separate sediments which contain average levels of dioxin above the 1 ppb from those below 1 ppb. It may turn out that this separation could not be implemented and that the entire 40,000 cy of material may need to be treated. The total cost estimate for treating the 40,000 cy is \$22 million. Conversely, sampling of the sediments could indicate that the quantity of material requiring treatment is less than 25,000 cy, and concurrently the cost estimate would decrease. A smaller quantity of material may result in a higher treatment cost per ton depending on the quantity material requiring treatment. The cost per ton to thermally treat wastes with transportable units generally increases as the quantity of material requiring treatment decreases. This effect becomes more pronounced as the quantity of material is reduced below 10,000 cy.

Cost for Operation and Maintenance/Potential Future Remedial Action

Costs for operation and maintenance should be close to the same or those identified in Alternative 1. These costs are estimated to be \$5000/yr of operation. At present it doesn't appear that this alternative would result in any costs related to future remedial action except for potential major repairs.

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ALTERNATIVE 3 - ON-SITE THERMAL DESTRUCTION/OFF-SITE
DISPOSAL OF RESIDUALS

This alternative is identical to Alternative 2 except that it makes two assumptions. The first assumption is that the thermally treated sediment residuals would be delisted. The second assumption is that a subtitle D secure landfill would accept the residual materials for disposal. As in Alternative 2 the untreated sediments containing an average dioxin concentration less than 1 ppb would be disposed in the on-site containment facility. If an appreciable quantity of residuals were delisted and disposed of off-site, it is possible that the containment facility would be altered prior to closure to account for the reduced volume of material.

Reduction of Existing Risks

Risks reduction under this alternative is identical to that under Alternative 2.

Protection of Community and Workers During Remediation

Since the actions required to implement this alternative would essentially be the same as those required under Alternative 2, (up to the point of residual disposal) the same protective measures would also be implemented. Additionally, this alternative would require that measures be taken to minimize the impacts of truck traffic to and from the off-site disposal facility during disposal of residuals. For example, the hours when trucks would be permitted to leave and enter the site could be limited. In addition, measures would have to be taken to ensure that the trucks were decontaminated prior to leaving the site and that spill contingency plans were intact. It should be noted that the residual material to be transported would be in a treated detoxified state.

Permanent and Significant Reduction of Mobility, Toxicity
or Volume

Discussion of reduction of mobility, toxicity or volume would be identical to that provided for Alternative 2. The only difference being that the volume of material disposed on-site would be reduced.

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Compliance with Applicable or Relevant and Appropriate Requirements

Discussion regarding compliance with applicable or relevant and appropriate requirements is identical to that for Alternative 2. In addition prior to off-site disposal of the treated sediments to a secure facility, the sediments would have to be delisted.

Time Until Protection Is Achieved

Protection would be achieved in essentially the same time frame as in Alternative 2.

Long Term Reliability/Potential Need for Replacement

As is the case with Alternative 2, this alternative would provide a high degree of long term reliability. The material remaining in the containment facility would have an average dioxin concentration of less than 1 ppb. Upon completion of thermal destruction, the currently designed containment facility may need to be altered since the amount of material requiring containment may be substantially reduced. Timing for replacement of the scaled down facility would probably be similar to that for the Alternative 2 containment facility.

Magnitude of Residual Risks/Prevention of Future Exposure to Residuals

As stated above the residual risks associated with containment of the sediments (less than 1 ppb dioxin) would be insignificant. Measures taken to prevent future exposure to residuals would be identical to those identified for the containment of untreated sediments (see Alternative 1).

Costs for Implementing Remedial Action

The costs for the treatment portion of the alternative are identical to those provided under Alternative 2. Additional costs would be incurred for transportation of residual material to the off-site disposal facility and disposal of the residuals. Additional costs may be incurred if the containment facility needs to be altered.

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Assuming 25,000 cy of sediments require treatment and that the volume of the residual treated sediment (moisture free) is also about 25,000 cy, then approximately 1500 (17cy) truck loads of material would need to be disposed off-site. Assuming that a disposal facility is located within 100 miles of the facility, and cost per loaded mile is \$3.50, then transportation costs would total \$525,000. Disposal costs at a subtitle D facility are estimated to be \$981,000 (assuming a tipping fee \$35 per ton and a conversion factor of 1.12 tons/cy for moisture free residuals).

Total cost for this alternative including thermal destruction and disposal of 25,000 cy of sediment would be \$15 million. Therefore, the complete remedial action cost for excavation of the creeks (1985 ROD) and treatment and disposal of the sediments would be approximately \$28 million.

Costs of Operation and Maintenance/Potential Future Remedial Action

Operation and maintenance costs are estimated to be of the same order of magnitude as for a 40,000 cy facility. The cost estimate is \$3,000/yr for the smaller facility. The only potential remedial action costs are those for major repairs or replacement.

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APPENDIX A

DISCUSSION AND INITIAL SCREENING OF TECHNOLOGIES/DISPOSAL
OPTIONS

Numerous treatment/destruction and disposal technologies were considered in this report. This appendix screens technologies according to factors specified in the National Contingency Plan (NCP) 300.68(g). The evaluation of alternatives reflects a preference for permanent remedies and alternative treatment technologies to the maximum extent practicable, as specified in Section 121 of the Superfund Amendments and Reauthorization Act (SARA). The alternatives were evaluated as they pertain to the selection of a permanent remedy for the dioxin-contaminated creek sediments and the 400-500 cy of dioxin-contaminated sewer sediments.

ON-SITE DISPOSAL

Final Disposal in Currently Designed Interim
Containment Facility

This alternative would consist of final disposal of the creek and sewer sediments in the currently designed interim containment facility. The storage facility is designed to assure the safe storage of these sediments.

The main route of transport of the contaminant of concern (dioxin) is sediment transport. This is due to the fact that dioxin is not volatile, has limited solubility in water and binds tightly to soil. Transport of sediment out of the closed facility as well as potential migration of other contaminants through volatilization, groundwater transport, or leachate generation, will be controlled by the following components of the facility design: The facility will meet all current RCRA hazardous waste landfill requirements. It will contain leachate collection and leak detection systems and a double synthetic liner. Any leachate generated will be treated by the existing treatment facility. The cover will contain an impermeable synthetic liner and will prevent infiltration of rain water and volatilization of contaminants. The facility will be built above ground and will incorporate other measures to prevent groundwater infiltration. The facility will be located inside the Love Canal fence or extended fence. The existing drain system and perimeter groundwater wells and additional wells to be installed will provide the monitoring required under SARA for land disposal units. Pages 6-51 through 6-57, and 6-71 through 6-74 of the CH2M Hill report provide specific details of typical storage facility designs.

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During storage, the facility will appear as an elevated mound. The highest point of the facility will be 23 to 25 feet above the existing ground elevation. Therefore it will be 10-12 feet above the maximum elevation of the existing canal cap. During the public meeting on the CH2M HILL report, the community objected to indefinite storage of the sediments. The Niagara Falls City Council and the Love Canal Area Revitalization Agency have passed resolutions opposing storage of creek sediments on the Love Canal site for any period of time. However, as stated above, the disposal facility will be constructed to prevent potential contaminant release and will be monitored closely. Based upon this preliminary evaluation it was determined that this alternative should be considered in the detailed alternatives analysis in Section 3.

Disposal Beneath Expanded Cap of Love Canal Proper

Disposal of wastes at Love Canal proper under an expanded cap is merely a permanent version of the CH2M Hill, In-Cap Storage alternative. That alternative is evaluated on pages 6-63 through 6-70 of the CH2M Hill report. The estimated amount of material to be placed beneath the expanded cap is likely to compromise the integrity of the existing containment system. This alternative would result in the potential for increased public exposure to contaminated materials presently buried beneath the cap. In addition, the community opposed in-cap interim storage of the creek sediments. For these reasons this alternative was not discussed in the detailed analysis.

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OFF-SITE LAND DISPOSAL

The potential for disposal of dioxin wastes in commercial landfills is still not likely, as no commercial facilities are presently permitted to dispose of dioxin-contaminated wastes. It does not appear as though this situation will change in the near future, since no commercial facilities have yet completed an application for modification to their existing permit for the acceptance of dioxin-contaminated waste.

The RCRA amendments of 1984 make the prospects for land disposal of dioxin wastes even less likely. Under the new law, Congress enacted a set of provisions which severely restrict the disposal of wastes on land. The provisions were enacted to protect human health and the environment by minimizing the potential for releases of hazardous material into the environment from land disposal facilities.

A requirement of the new law calls for EPA to ban land disposal of dioxin or provide a mechanism for assuring that land disposal of dioxin wastes (on a waste specific basis) will not be harmful to human health or the environment.

On November 7, 1986 in response to the Congressional mandate, EPA established screening levels for the constituents of concern including three chlorinated dioxins. These screening levels were established using a modeling approach.

Levels were established for three chlorinated dioxins: tetrachlorinated dioxins, pentachlorinated dioxins, and hexachlorinated dioxins. These constituent levels, which were determined to be protective of human health and the environment, represent maximum allowable concentrations for individual constituents in extracts (leachates) of dioxin-containing hazardous wastes. The levels for each of these dioxins in the extract is 1 ppb.

If the concentration of dioxin in the extract exceeds the 1 ppb level then the waste must be treated such that the concentration of the dioxin in the extract no longer exceeds the 1 ppb level. At that point in time the waste could be land disposed at an appropriate facility.

The regulation becomes effective on November 8, 1988. Current requirements remain in effect until this date.

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Based upon the above discussion, off-site land disposal of the wastes could be feasible under the following circumstances:

- Case 1: -The sediments are withdrawn from the creeks and are in a dewatered state prior to November 8, 1988.
-A commercial facility makes the marketing decision to accept dioxin wastes
-The facility is permitted to dispose of dioxin-contaminated waste

- Case 2: -Disposal is planned for a date after November 8, 1988
-A commercial facility makes the marketing decision to accept dioxin-contaminated wastes
-The commercial facility is permitted to handle the levels of wastes identified in the rulemaking
-The waste passes the Toxicity Characteristic Leaching Procedure (TCLP) test (i.e. it is below the 1 ppb screening level for tetra, hepta and hexa chlorinated dioxins).

- Case 3: -The excavated sediments are downgraded or delisted.*

* A petition to delist wastes can be filed based upon provisions in the hazardous waste regulations (40 CFR 260.20 and 260.22). These provisions allow persons the opportunity to demonstrate that a specific waste from a particular generating facility should not be treated as a hazardous waste. The petition must show that the waste is not hazardous based upon the criteria for which it was originally listed, and show that no additional factors cause the waste to be hazardous. Similarly, an acutely hazardous waste, such as dioxin wastes, can be downgraded to a hazardous waste classification based upon the same provisions. A delisted waste is no longer regulated under RCRA hazardous waste regulations. A waste which is downgraded from acutely hazardous to hazardous is still regulated under RCRA hazardous waste regulations, however, it can be disposed of in an appropriate facility.

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The present climate of off-site land disposal is very
nebulous. It is impossible at this point in time to
classify this alternative as feasible. Therefore, this
alternative was not retained for further consideration.

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ON-SITE TREATMENT (CHEMICAL, PHYSICAL, BIOLOGICAL)

Chapter 6 of the CH2M HILL Report briefly summarizes various innovative technologies and research that is being conducted on treatment methods for dioxin-contaminated soils.

Pursuant to Section 121 of SARA, this section will further evaluate remedial treatment technologies that are intended to significantly reduce the mobility, toxicity or volume of dioxin wastes at the site. An updated discussion of the various technologies mentioned in the CH2M HILL report plus any additional technology which may be applicable to the on-site treatment of Love Canal dioxin-contaminated sediments will also be covered in this section. Each technology and research project will be categorized into either chemical, physical or biological treatment types. These technologies will be screened based upon human health and environmental concerns, and their effectiveness for decontaminating dioxin-laden sediments with initial dioxin concentrations in the low part per billion range.

Table A-1 lists each research project and technology by treatment type, and summarizes the feasibility and effectiveness of each.

The technologies to be discussed in the following evaluation have not achieved the preferred stage of development for utilization at Love Canal. Most of these technologies are aimed at treating dioxin-contaminated soils, however, none have demonstrated the desired destruction and removal efficiencies (DREs) for initial dioxin concentrations in the low part per billion range.

Chemical dechlorination has been demonstrated to be more effective than most of the chemical, physical, and biological treatment methods in reducing dioxins in soils. This process has been tested on PCBs and dioxin-contaminated soils; however, it has not proven effective on soils and sediments with initial dioxin concentrations in the low part per billion range (as is the case with the Black and Bergholtz Creek sediments).

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TABLE A-1
ON-SITE TREATMENT TECHNOLOGY STATUS

TECHNOLOGY	APPLICABILITY FOR SEDIMENT DECONTAMINATION
1. <u>Chemical</u>	
Dechlorination - (APEG)	Not effective at dechlorinating sediments with initial dioxin concentrations in the low ppb range. High moisture content is a limiting factor. Upscaled field unit is being proposed (up to 10 tons/day).
Stabilization (K-20) Lopat	Not effective in stabilizing organics such as PCBs and dioxins in soil and sediments. Better suited for treatment of inorganics in soil.
Dechlorination PPM	More applicable to PCB-contaminated soils. Commercial soil washing unit for PCB soils proposed for mid 1987 start up in Canada. Should this system prove successful on PCBs, PPM will attempt its feasibility on dioxin-contaminated soils.
2. <u>Physical</u>	
In Situ Vitrification Battelle	The process is being evaluated for PCBs, but has not been tested on dioxin.
Vitrification Geotech	A moisture content of less than 5% is required for process to operate efficiently, therefore it is not effective on Love Canal Sediments.
Supercritical Water Oxidation Modar	Destruction efficiencies of greater than 99.99% were achieved on aqueous chlorinated hydrocarbon compounds, including PCBs. Tests have not been conducted on dioxin-contaminated slurries and soils.
Wet Air Oxidation	PCBs and dioxins are resistant to this process.
3. <u>Biological</u>	
Natural Biodegradation Agro K	Research results are inconclusive for destruction of dioxin in soils. Not effective on sediments with initial dioxin concentrations in the low ppb. range.
Dioxin Transport in Soil Monsanto	Short-term exposure impacts to residents from volatilization. Better suited for non-residential area. Research efforts to date have little utility and practical application to decontaminating dioxin soils and sediments.
Biological Degradation Occidental	No microbes have been identified that can effectively degrade dioxin with initial concentrations in the low ppb (less than 50ppb.) range.

EPA-Chemical Dechlorination

EPA's Office of Research and Development (ORD) is testing the use of alkaline polyethylene glycolates (APEG) (e.g., NaPEG or KPEG) as reagents for neutralizing PCBs, dioxins and other chlorinated hydrocarbons in the environment. The process was originally developed for the treatment of transformer fluids. Laboratory tests have proven reductions of PCB concentrations in oils from 1000 ppm to less than 1 ppm.

ORD is currently testing the NaPEG reagents application on PCB and dioxin-contaminated soils. The reagent can either be applied in-situ or in a slurry. Treating soils by a slurry process has been demonstrated to be a more consistent application method and involves fewer environmental interferences. Laboratory scale and field demonstrations utilizing both in-situ and slurry processes have yielded destruction and removal efficiencies (DREs) of 99.99% (four 9's) for both PCBs and dioxin. This process has not been able to demonstrate, however, the six 9's DRE for 2,3,7,8-TCDD, which has been achieved by certain thermal destruction methods. The slurry process involves mixing the soil and reagent together in a reactor and applying heat to drive off excess moisture to facilitate the dehalogenation. Previous field demonstrations have utilized reactors ranging from 55 gallon drums to 25 gallon mechanical mixing reactors. An upscaled unit has recently been designed with a reactor capacity of 2 tons. This reactor is expected to be utilized on a field demonstration scale at two New York State Superfund sites in the summer of 1987. Based on a feed rate of 10 tons/day (assume 5 batches/day X 2 ton reactor) it would take approximately eleven (11) years to dehalogenate 40,000 cy of sediments.

Based on field demonstrations, estimated costs for utilizing this process on dioxin-contaminated soils are approximately \$100 to \$300/ton of soil. No commercial application utilizing this process on soils is available at this time.

Use of this process at Love Canal would be limited due to the high moisture content (approximately 50%) of the sediments. Finally, these APEG processes have not been demonstrated effective on sediments with initial dioxin concentrations in the low ppb range. Therefore, these processes were not considered for further evaluation.

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Lopat Enterprise, Inc. - K-20

The Lopat Enterprise, Inc. chemical stabilizing agent, K-20, is a water-soluble base silicate fixative. Unlike conventional chemical fixation and stabilization products K-20 is effective in stabilizing organic compounds (i.e. PCBs, dioxin, pesticides) as well as inorganic compounds (i.e. heavy metals) in concrete, asbestos and other inorganic media. However, destruction of PCBs, dioxin and other organic compounds in soil is highly limited due to the elevated naturally occurring organic (carbon) content in the soil, which inhibits the K-20 process. Numerous applications however, were successful in utilizing K-20 on lead and other heavy metals in soils. For example, when mixed with portland cement and soil with a lead content of 200 part per million (ppm), K-20 reduced the measured lead level to 0.1 ppm according to EPA's EP Toxicity Test.

An efficient method for utilizing the K-20 process on soils contaminated with organics and metals would be in conjunction with incineration. The low organic content and residual metals in the ash would provide ideal conditions for this stabilization process.

Lopat maintains that the base silicates it uses in its process have been used for other purposes for many years, and that its products encapsulation ability should be effective for at least 20 years. No evidence presently exists, however, to support this statement.

Precise cost data is waste specific. Cost depends on the quantity of K-20 needed, which in turn depends on the nature of contaminated material, the contaminants, and the need for additional agents such as cement. Lopat has estimated however, that it would cost approximately \$25/ton for the stabilizing materials to reduce the concentration of lead in soils from 250 ppm to 5ppm. This estimate does not include soils preparation, handling and labor. For treatment of contaminated soils, some equipment would be necessary to insure thorough mixing of K-20 and soil. Due to the limitations of this technology as mentioned above, this alternative was not retained for further consideration.

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PPM, Inc.

PPM's dechlorination process for liquids (i.e. oil) utilizes an organo-sodium reagent that converts the chlorine in polychlorinated biphenyl (PCB) into sodium chloride. This process has wide commercial use, however it would not be applicable to Love Canal since it is only utilized on liquids (oils). PPM has, however, developed a process that can be utilized on soils and sediments. This process utilizes an alkaline polyethylene glycolate (APEG) reagent which is virtually identical to the EPA ORD process mentioned earlier in this section. This process involves washing the contaminated soil or sediments in a slurry mode mechanical system. The process removes the PCB molecule from the medium, resulting in final end products of decontaminated soil and a concentrated PCB-contaminated liquid waste stream. This waste stream can then either be passed through PPM's dechlorination process for liquids or disposed of by other environmentally-sound methods. PPM claims PCB removal efficiencies to be limited by instrument detection limits, which are dependent on the number of passes through the soil washing process. Presently, PPM has only tested its soils washing process on PCBs. Should this system prove successful, PPM will attempt its feasibility on dioxin-contaminated soils.

Since PPM is attempting to develop a mechanical system for treating the soil in a continuous rather than batch mode, various problems are being encountered that have delayed the systems successful utilization. One major limitation PPM has been faced with at this time is the difficulty with treating soils utilizing a mechanical system. Problems encountered include particle filtering, system clogging, shortened pump life and incomplete soil and solvent mixing. It is therefore unlikely that this system would be available for timely treatment of Love Canal sediments.

By mid 1987, PPM intends to design and operate a scaled-up commercial unit in Canada for removing PCBs from soils. In the near future, PPM intends to apply for an experimental permit to demonstrate their PCB soil washing process at their Georgia facility. PPM has expressed willingness toward conducting a pilot demonstration of their soil washing process at a Superfund site, should the demand arise. This demonstration would be limited, however, to PCBs.

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Although precise cost data has not been established at this time, PPM estimates a cost of approximately \$1000 to treat one ton of soil.

Due to the inability of this system to exhibit destruction efficiencies that are necessary for the Love Canal dioxin-laden sediments, further analysis of this technology was not conducted in this report.

Battelle - In Situ Vitrification

In situ vitrification (ISV) is a process developed at Battelle, Pacific Northwest Laboratories for the U.S. Department of Energy as an in-place stabilization technique for radioactive-contaminated soils. The process is being evaluated for potential application to soils contaminated with hazardous wastes, such as PCBs. Although this process has never been tested on dioxin-contaminated materials, Battelle has expressed a willingness to conduct ISV bench or engineering scale tests on dioxin-contaminated soils or sediments.

The ISV process involves the insertion of four electrodes into the contaminated soil in a square array. A path for electric current is established, which creates temperatures high enough to melt a layer of soil. This molten zone continues to grow, encompassing the entire volume of contaminated soil between electrodes. At these high temperatures ($>1700^{\circ}\text{C}$) created, organic materials pyrolyze, diffuse to the surface and combust. Any off-gases are collected, monitored and treated. Remaining ash, along with other non-combustible materials dissolve or become encapsulated in the molten soil. The molten soil cools to a durable glass and crystalline formation. According to Battelle, the ash resulting from this process has never been tested to determine the presence of hazardous constituents. Ash generated from this process would need to be delisted.

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The ISV process is best suited where processing at depths of greater than approximately ten feet is required. If contamination is near surface, it would be more economical to remove the soil and stage it in a deeper trench for ISV processing. If the ISV process is proven in the future to be effective on dioxin sediments, the only suitable application at Love Canal would be in conjunction with the sediment storage facility, assuming a depth of approximately ten feet.

Process costs vary from site to site, depending on soil moisture content and power rates, but generally costs are less than \$10/ft³ (\$270/ton). The cost estimate can be vastly increased when utilizing this process on Love Canal sediments with moisture content of approximately 50%. The higher the moisture content, the greater the energy demand of the process.

Battelle will work with industry and government on a contract basis to tailor a processing system to their needs. They could provide a feasibility study to assess costs and scope of the system's application, engineering scale studies to demonstrate effectiveness and pilot-scale development to simulate commercial operation and assistance in commercial development and operation.

Battelle has pilot units and a research and development permit from EPA Region 10 to accept PCB waste at their facility. This process, as stated above, has not been tested on dioxin-contaminated soils or sediments and will prohibit the use of future treatment alternatives. Therefore, the ISV process was not recommended for further consideration.

Geotech Melt-All System

The Melt-All system is a continual melt process by which the waste material is melted in a furnace and converted into an inert glass-like material, pellets or a spin fiber material. The system produces temperatures from 2200-6200°F, which, it is claimed, can be precisely adjusted. Previous melts with fly ash have yielded totally inert material that can be used as a growth medium for plants, material that absorbs 500 times its weight in liquid and can be used in oil spill cleanup, and material that can be molded into inert heat resistant jet airplane parts.

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The system has been used in France and Czechoslovakia and tests are underway in the United States. The company claims the system can be used to destroy fly ash, expended filter cake, contaminated soil, mine tailings, contaminated filter media, sewage sludge, high acid and petroleum sludges and residue of incinerated toxic liquid waste. In order for the process to run efficiently, a moisture content of less than 5% is required; therefore, pretreatment such as dewatering may be necessary.

The company has a pilot plant in operation in Pennsylvania. This unit measures 8 1/2 feet wide by 24 feet long by 24 feet high, and is housed in a simple Butler building. The pilot plant reaches a temperature of 5200°F, and has pour rates of 25-300 pounds per hour. Additional full-scale units that treat fly ash are operating with a pour rate of 8,000 pounds per hour. The pilot plant costs approximately \$3 million to construct; it is transportable, and can be erected and "shook down" in four days. While the system has never been tested on dioxin-contaminated soil, several tests of fly ash, tailings and sludge have yielded volume reductions of 90 percent.

Precise cost estimates for processing contaminated soil are not available. However, Geotech has estimated a cost for processing fly ash, of approximately \$50 per ton. This estimate is based on a cost of \$.10 per KWH of electricity and a moisture content of less than 5%. Higher moisture content will increase the cost substantially. Costs for pre-treatment (i.e., dewatering) and staging of the soils are not included in this estimate.

The Geotech pilot plant, with a stated capacity of 250 pounds poured per hour, could dispose of 40,000 cubic yards of sediments in an estimated thirty six years, assuming a linear relationship between pounds poured and pounds processed. The largest plant (8,000 pounds/hr.) could dispose of 40,000 cubic yards in roughly one year. However, This Melt-All system has never been tested on dioxin-contaminated soil, therefore, it would not be practical to attempt its utilization at Love Canal.

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Modar, Inc.

Modar's supercritical water oxidation operation is essentially a thermal destruction technology, but for purposes of this addendum will be discussed under innovative physical on-site treatment.

The supercritical water oxidation process is based on the ability of water to perform as a solvent for organics at a temperature and pressure exceeding 705°F and 3200 psi, respectively. When air is mixed with aqueous wastes above the critical temperature and pressure of water, organics are rapidly and completely oxidized to CO₂ and water. In addition, inorganic salts become almost insoluble at 930°F and precipitate out of the supercritical liquid. Bases, such as sodium hydroxide, are added to the waste to neutralize any inorganic acids formed during oxidation. The exothermic conditions during the oxidation reactions produce energy in excess of process energy requirements and, in principle, allow for the production of high pressure steam or electricity.

Modar has a continuous bench-scale unit in operation to characterize wastes and to determine optimum operating conditions for the process. The process is normally applicable to liquids containing organics; however, Modar intends to attempt its feasibility on solids.

The bench-scale unit is designed to handle 10 gal/day of 10% organics in water. Modar also has a commercial pilot unit able to treat 500 gal/day of 10% organics in water. Destruction and removal efficiencies with laboratory and field units have been demonstrated at >99.99% for a wide range of aqueous compounds including PCB oils and dioxin. The mobile pilot unit is currently available for on-site testing on small quantities of liquid hazardous waste. Modar has designed and intends to fabricate and possibly operate its first commercial (liquids only) transportable unit in late 1987. This unit will be capable of treating between 6000 to 10,000 gal/day. No cost data is available from Modar at this time.

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Modar is also currently lab testing the feasibility of treating spent activated carbon with supercritical water oxidation. The carbon would need to be pulverized and developed into a slurry, prior to treatment.

Presently, Modar has not tested the supercritical water oxidation process on soils and/or sediments, therefore its use at Love Canal is prohibited. This alternative was not carried through for further detailed analysis.

Wet Air Oxidation

Wet Air Oxidation (WAO) is a treatment technology which breaks down organic materials by flameless oxidation. Destruction is achieved by subjecting the waste to elevated temperatures and pressures. The resulting exothermic reactions are self-sustaining and even capable of generating by-product steam. This technology is applicable to dissolved or suspended organic substances in the form of liquid wastes and sludges. WAO could not be used on Love Canal sediments since dioxins are resistant to this process, therefore, this technology was not retained for further consideration.

Agro K - Natural Biodegradation

Agro K Co. is studying the use of an enzyme additive to enhance natural biodegradation. In theory, the enzyme dissolves the chemical bond between soil and dioxin, leaving the dioxin molecule available for decomposition by naturally occurring soil bacteria. Agro K's test plot research results at Times Beach are inconclusive, but several samples did show a reduction in contamination levels. This research at Times Beach is expected to continue until conclusive results are obtained. An advantage of the enzyme treatment is that the enzymes are completely organic and biodegradable and theoretically produce no hazardous by-products.

Agro K is also investigating chemical degradation of PCB and dioxin in soils. Conclusive results have not been received. Therefore, this process was not be considered for further evaluation.

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Monsanto - Transport of Dioxin in Soil and
Destruction by Sunlight

Monsanto has developed a laboratory transport model which concludes dioxin naturally migrates upward toward the soil surface over time (years). When dioxin reaches the surface, sunlight (photo reaction) naturally destroys the dioxin. Low permeability soils (i.e. clay) lengthen the natural rate of movement of dioxin. Should the soil be continuously mixed however, the process could be expedited. Monsanto anticipates the possible future use of this process, or a variation of, as a simple, low-cost alternative to cleaning up certain dioxin-contaminated sites.

Testing of this transport theory is being conducted in Times Beach soil test plots. The test plot has dimensions of 8ft by 6ft by 2ft deep with an initial dioxin concentration of approximately 150 ppb. After one year of research, dioxin concentrations in the top 3 mm of soil were reduced to approximately 30 ppb. Additional sampling results from this research are expected in late 1987.

Due to the potential for short term public health impacts from wind borne transport of dioxin-contaminated sediments, and volatilization of contaminants, this alternative would not be viable for use in residential areas. For these reasons, this process was not evaluated in further detail.

Occidental Chemical - Biological Degradation

Occidental Chemical has been conducting research in the biological degradation of chlorinated organic compounds for approximately five years. They have conducted research with naturally occurring organisms which were obtained from the Hyde Park Landfill. Occidental has completed research utilizing genetic engineering techniques to develop organisms with selected characteristics which would have an affinity for degrading most chlorinated organics (i.e. chlorinated benzenes, phenols, toluene, lindane, pentachlorophenol). Occidental is currently involved with a program to evaluate the feasibility of degrading dioxin but these efforts have proven unsuccessful.

Occidental has not been able to identify microbes that can effectively degrade dioxin with initial concentrations in the low ppb (less than 50 ppb) range. Therefore this alternative is not retained for further analysis.

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THERMAL DESTRUCTION

Process descriptions for the thermal destruction technologies discussed in this addendum, were provided in the CH2M HILL report. The reader is referred to specific sections of that report: pages A-1 through A-9 for a discussion of rotary kiln and fluidized bed incineration processes; pages A-33, for a description of High-Temperature Fluid-Wall Reactors. Plasma Arc pyrolysis is discussed in this section. A process which was not discussed in the CH2M HILL report was Shirco's infrared incineration system. This process will be discussed in this Appendix.

There have been a number of advances pertaining to thermal destruction of hazardous waste, especially dioxin-laden waste, since the completion of the FS prepared by CH2M HILL. As noted at that time, the RCRA dioxin regulations of January 14, 1985, (effective July 15, 1985) require that a thermal destruction unit planning to treat dioxin wastes prove six 9's destruction and removal efficiency (DRE) of organic compounds which are as difficult or more difficult to burn than the tetra, penta, and hexa chlorinated dioxins. These chlorinated dioxins are considered to be acutely hazardous waste and are subject to more stringent regulations than wastes classified as hazardous.

Those regulations also state that residues resulting from the treatment of dioxin wastes are also considered acutely hazardous wastes with the exception of residues resulting from the six 9's DRE thermal treatment of dioxin-contaminated soils. These soil residues are downgraded to RCRA hazardous wastes. In either case, residues generated from thermal treatment would be hazardous waste and would have to be treated as such unless they could be delisted.

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Successful Thermal Destruction of Dioxin-Contaminated Soils and Liquids

No thermal destruction units were permitted or certified to treat dioxin wastes when the Record Of Decision was signed on May 6, 1985. Since that time, the EPA mobile incineration system (MIS) completed trial burns on dioxin-contaminated wastes from the Denney Farm site in McDowell, MO.

The final results of the trial burn show the MIS successfully destroyed wastes contaminated with up to 357 parts per million (ppm) of 2,3,7,8,-TCCD, in four test burns. It was the first time that dioxin had been destroyed in both contaminated solids and liquids in a full field evaluation.

The incinerator system met the federal requirement of six 9's DRE. Local, state and federal authorities monitored the test burns to make sure that the system was operated safely. Based upon the test burn results, the MIS was permitted to continue to burn both liquid and solid dioxin wastes at the Denney Farm site.

Successful Petition to Delist Residues From the Thermal Destruction of Dioxin-Contaminated Waste

Another milestone related to the treatment of dioxin wastes also resulted from operation of the MIS at Denney Farm. On July 25, 1985 EPA acted on a petition to delist wastes generated by the MIS in its operation at Denney Farm. The petition was filed based upon provisions in the hazardous waste regulations (40 CFR 260.20 and 260.22). These provisions allow persons the opportunity to demonstrate that a specific waste from a particular generating facility should not be treated as a hazardous waste. The petition must show that the waste is not hazardous based upon the criteria for which it was originally listed, and show that no additional factors cause the waste to be hazardous.

The Agency granted an exclusion for the process wastewater, ash and other solid residues for the MIS during its field demonstration at Denney Farm. The exclusion was contingent upon 1) the proper functioning of the MIS and 2) periodic grab sampling of the excluded residues to assure that specific levels of chromium, mercury, and selenium were not being exceeded. Based upon this action the filtered process wastewater has been drip irrigated on-site and the treated soil has been used as fill on the site.

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Other Successful Demonstrations of Thermal Destruction
of Dioxin-Contaminated Waste

During the period of July 8 through July 12, 1985 the Shirco Infrared Systems Portable Unit was on-site at the Times Beach Dioxin Research Facility to test burn soil laden with 2,3,7,8 TCDD. Equipment set-up, preliminary operation, test operation, decontamination and shake down was included in this period. Operation of the furnace system to decontaminate the dioxin-laden soil, as well as sampling of the emissions, feed and discharge streams was accomplished on July 10 and 11. The Missouri Department of Natural Resources Environmental Division coordinated the site preparation. Two tests were performed. In each test 48 lb/hr of soil contaminated with 155-230 ppb 2,3,7,8 TCDD was fed to the system. A total of approximately 1,000 pounds of contaminated soil was incinerated.

Test results showed that the Shirco unit was able to achieve dioxin DREs above the 99.9999 percent level in both test cases. In addition, residual dioxin in the soil was not detected at a level of 33 to 38 parts per trillion (ppt).

Test burns were also performed on dioxin-contaminated wastes from the Vertac site located in Arkansas. These wastes were burned at EPA's Combustion Research Facility located in Jefferson, Arkansas. A series of tests were performed (September 1985) with still bottom wastes which contained up to 30 ppm of dioxin. Since these wastes had a waxy consistency at ambient temperatures, they were heated to a liquid state prior to injection into the liquid injection incinerator unit. Results indicated that the injection unit was able to achieve six 9's DRE.

In November 1986, EPA Region I conducted a test burn on approximately 4 cubic yards of soil at the Tibbetts Road site in Barrington, New Hampshire. The solids contained up to 42 ppb pentachlorodibenzodioxin, 9500 ppm of PCBs and additional organic compounds. The burn was performed on-site utilizing a transportable Shirco pilot unit with a capacity of 100 pounds/hour. Sampling results for the test burn are expected in summer/fall 1987.

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Planned Trial "Burns" of Dioxin-Contaminated Love Canal
Leachate Treatment Sludge with the Plasma Arc Unit

The New York State Department of Environmental Conservation (DEC), and EPA's Office of Research and Development Hazardous Waste Engineering Laboratory (EPA-ORD), will conduct joint testing and demonstration of a mobile plasma arc unit (PAU) under the federal Superfund Innovative Technology Evaluation (SITE) program.

The PAU thermally destroys liquid wastes in the absence of oxygen, a process known as pyrolysis. The PAU is a reactor in which 350 kilowatts of electricity are utilized to form a plasma. The process uses energy from ionized gas molecules, created by the electrical current discharge through a vortex of low pressure gas, to destroy wastes. Temperatures in the reactor are in the range of 18,000°F. Wastes pumped through the plasma arc undergo rapid decomposition into their chemical constituents. The constituents are primarily carbon particles which are removed with a scrubber; gaseous hydrogen chloride which is removed with a scrubber and neutralized; and hydrogen which is flared. The PAU's process rate is about one gallon of waste feed per minute.

In 1982, EPA-ORD and DEC established a Cooperative Agreement to conduct plasma arc research for the purpose of destroying the sludge from the Love Canal leachate treatment facility. To carry out this Cooperative Agreement, the DEC contracted with Pyrolysis Systems, Inc. (PSI) to design, construct and evaluate the PAU. The DEC-PSI contract calls for the intended work to be completed in a series of phases:

- Phase I - Construction of the PAU;
- Phase II - Testing of the PAU in Canada;
- Phase III - Testing of the PAU at the Love Canal site;
- Phase IV - Demonstration of the PAU for the destruction of the Love Canal sludge;
- Phase V - Destruction of total sludge inventory.

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The tasks through Phase II have been completed, and the PAU is currently staged at the Love Canal site. Canadian testing appears to indicate that the unit is capable of achieving six nine's thermal destruction on methyl ethyl-ketone, carbon tetrachloride, and PCB transformer-fluid. The PAU is only capable of treating liquid wastes and could not be used to treat the creek or sewer sediment. However, its performance to date indicates that it should be capable of destroying liquid wastes containing dioxin such as the Love Canal treatment plant sludge.

Plans for Phases III and IV are currently being developed. Although a RCRA permit is not required for Phases III and IV (permits are not required for Superfund-financed on-site remedial actions) the substantive technical requirements of a RCRA permit must be satisfied. Once "trial burn" plans and other pertinent regulatory related plans have been approved by EPA and DEC regulatory staffs, "trial burns" (Phase III of the program) will be initiated.

Included in the trial burns will be a test on the Love Canal sludge. Other surrogate compounds will also be used for test burns during this phase. The trial burns are presently scheduled for Fall of 1987 and Spring of 1988. Phase IV will be carried out subsequent to review of the "trial burn" data. Phase IV will consist of twenty, eight hour "burns" of the Love Canal sludge over a four-week period.

EPA-ORD/DEC will continue joint efforts to implement Phases III and IV as specified above. The DEC and its contractor, PSI, will be responsible for operation of the PAU and the EPA will be responsible for the sampling and analysis during the testing and demonstration period. A detailed schedule and evaluation plan for Phases III and IV will be developed by both parties. The evaluation plan will include details on the testing and demonstration procedures and protocols, sampling and analysis, and Quality Assurance/Quality Control (QA/QC).

If Phases III and IV are successful, the information generated may be used in a study to determine the best alternative for destruction of the Love Canal sludge. If it is determined that the PAU should be utilized for destruction of the remaining inventory of sludge then Phase V will be initiated.

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On-Site Thermal Destruction (Transportable Unit)

The advances outlined above coupled with SARA have helped spur an interest in the transportable thermal destruction unit market. Several firms have designs or plans for fabrication of transportable units, other firms have proceeded with fabrication in anticipation of market conditions.

Table A-2 provides information pertaining to planned or existing transportable thermal destruction units (TTDU). The information contained in Table A-2 was supplied to EPA Region II by the proprietors of the transportable units. It should be noted that the table is not intended to provide a complete listing of available or planned TTDU's.

For the most part Table A-2 is self explanatory. Column one of the table identifies the proprietor of the unit; the location of the proprietor; the type of thermal destruction technology employed by the unit; and the size of the unit as indicated by the BTU/hr rating, core size, inner diameter, etc.

The majority of the units listed in Table A-2 such as Detoxco's, ENSCO's, Fuller Power Corp's and the EPA MIS are of conventional rotary kiln incinerator (RKI) design. Pedco's cascading rotary kiln incineration system is a variation of a conventional rotary kiln incinerator. Pedco's unit rotates 10-20 revolutions per minute (rpm) whereas a typical RKI will only rotate 1-3 rpm. The increased turbulence is intended to improve solids to gas contact. Ogden Environmental Services' (formerly GA Technologies) circulating bed combustor (CBC) is a variation of the fluidized bed incinerator design. The incinerator uses high air velocity and a circulation of the solid waste material to create a highly turbulent combustion zone. The increased turbulence allows the incinerator to operate efficiently at relatively lower temperatures (1450-1600°F).

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TABLE A-2 PLACED AND EXISTING RESPONSIBLE PERSON, PRESENT STATUS

UNIT	PLACED				EXISTING CONDITIONS		SINKS CORREL. (YES/NO) ON SCS CORREL.	REASON TYPE/REASON	PRESENT STATUS		COMMENTS
	EXISTING YES/NO	DATE OF COMPLETION REASON	RESPONSIBLE PERSON	TEMPERATURE (°F)	CORROSION RATE EXTENSION TIME	REASON TYPE/REASON			REASON TYPE/REASON		
1-GENERAL SERVICE SERVICES											
San Diego, CA (Corroding and Corroding and Corroding)											
-16-inch 18, 2000-400 transportable CMC pilot unit exists	Yes			Liquid, solids	1400 to 1600	Solids- corrosion to hours pilot-12 sec.	1.0	YES-Conducted on transport, pilot unit 2/78. SEE 1 28, 29, 30 for PCD 1240 and 1250 at 10,000ppm & trichloroethylene at 1,000ppm.	CD-4 permit for transport, pilot unit in 520 Reg. 11, 12/277.		
-16-inch 18, 2000-400 transportable CMC unit	Yes		late 1980	"	"	"	"		YES- Transportable units approved for PCD units 2/78-4/78 MB		The 16-in. 18 unit has been delivered to a Canadian agency.
-36-inch 18 6-2000-400 transportable CMC unit in construction	No	4/78	Reg-100 1987	"	"	"	2.5				Expect to conduct tests with the 36-inch 18 unit under the SITE program at a Reg. 11 site (near 400)
2-CHOC/PROCESSES											
Franklin, MO (Chlorine Site Incinerator)											
-10000-400 rotary kiln, waste fired boiler fired facility	Yes										
-Two 10000-400 liquid injection units incinerator	Yes										
-Three 10000-400 rotary kiln trans- portable incinerators- 400-4000											
Unit 1	Yes	11/83	12/84	Liquids, solids	1400-1600 to 1800 Pilot-1400- Corrosion, 2400	Solids-20 min. to 1 hour pilot-2 sec.	4.0	Unit 2 YES-Conducted Reg. VI trial burn 2/78. Achieved four 9's for CCM coverage. Need to repeat tests with a new diene surrogate since all tests didn't reach six 9's. YES- (1/78) trial burn results indicate seven 9's CMC for PCD contaminated liquids and solids.	Unit 2 CCM- Permit application and demonstration test plan approved by CDB, MB YES- Burn status with Reg. VI. Expect decision on YES permit 4/4/77.		Unit 1 has lowest coverage and contaminated oil. It is being retrofitted for work at an Illinois CCM site. Expect unit 2 to operate at the Merter diene site.
Unit 2	Yes	11/83	7/85	"	"	"	"				
Unit 3	Yes	11/83	2/85	"	"	"	"				
Unit 4	No	11/83	7/87	"	"	"	"				
Unit 5	No	11/83	9/87	"	"	"	"				
								Unit 3 YES demonstration burn results for diene contaminated oils due 4/87.	Unit 3 YES permit for YES cleanup.		Unit 3 is at the Gulfport, MS Dept. of Defense diene site.

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Burger, VI
Advanced Electric
Sector (AES)
Pyralis)

-3-inch core AER
field demonstration
out-maint. in a
single 45 ft. trailer

-6-inch core found No complete 10/21
 608 in Burger, FL.
 Used for certif. tests

**-12-inch core fluid
NEN in Super, VL
Commercial size, but
used for R+O and
certification tests**

24-inch core PEB No depends on demand
is possible if
demanded

-transportable (2)	to	design to deliver 1 liquid, 2nd compl. Would require solids 8-12 oz.	200 to 400	less than 2 seconds
--------------------	----	--	---------------	------------------------

3 inch unit has driven coil burn data from Tiers Beach testing. Both the 3 inch and 12 inch have burn data for establishment/dissim. 12 inch unit achieved six 9's plus, with PCB-contaminated soils.

RECN- Both the 3 inch and 12 inch units have Part #Pulsating diodes, 80V85-Texas Motor Corporation.
RECN- 12 inch unit has RECN for PCBs, 2-1/4" x 1/8" Region VI.

Posttreatment system included to crush and grind solids to a fine material. Solids must contain less than 25 moisture.

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* Dealer is no longer accepting any toxic or hazardous waste at either their fixed or transportable units for at least the next two years. This decision is based on poor market conditions.

They will not finalize the design & begin fabrication of a transportable unit until they procure a full-scale commercial jet for it.

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TABLE A-2 PLANNED AND EXISTING TRANSPORTABLE DIESEL THERMAL SYSTEMS

UNIT	EXISTING YES/NO	PLANNED DATE OF COMPLETION DESIGN	ACCEPTABLE FIBRE WASTE	OPERATING TEMPERATURE (°F)	CONVERSION TIME RETENTION TIME	APPROX. SOILS CAPAC. (TONS/HR.) AT 200 MESH.	DESIGN TYPE/REMARKS	PERMIT STATUS GRANTING PERMIT/COMPANCY	COMMENTS
4-SOURCE INFORMED									
Systems Dallas, TX (Infrared Furnace)									
-42 Existing mobile Pilot Units (1000/hr)	Yes		Liquids, solids	Pr. chamber 1600 to 2000 After burner 1800 to 2200	Primary chamber 5 to 30 minutes After burner 2.2 seconds	1000lb/hr.	NOB-4/65-Confidential 5/65-Confidential 6/65-Confidential 8/65-Confidential NOB-3/65-Confidential 4/65-Calculated cracked and Postchlorophenol contaminated soils took four-five 9's BSE for postchlorophenol at detection level. 7/65-Texas Beach dioxin con- taminated soil results indicate six 9's BSE were achieved. NOB in ash and scrubber water was non-detect at 6.4ppb and 1.0ppb detection levels respectively. 11/65-Cranston and Post-chloro- phenol and dioxin contaminated soils took four for International Paper Co.-TX. Six 9's BSE achieved on various PNC's.		8 mobile pilot unit was used at ERM Region 1 Tullahoma Mt. Superfund site in 11/65 on key of dioxin-contaminated soils. Results expected 4/67. ERM CAP has a Shiroe unit in storage (200 lb. soil/hr.). Shiroe Infrared systems are also used for regenerating activated carbon. First full-scale transportable unit was purchased by Martech Inc. and is being used at the Puch Hill Superfund site (PCB-contaminated) in Florida. Three additional full-scale transp units purchased by E.M. Materials, IT Corp. and Crestal Inc. are expected to be completed fabricatio in mid-1967. Additional transp. units will be fabricated upon demand.
-Existing fixed Pilot Unit (1000/hr)	Yes					1000lb/hr.			
-Transportable Unit 5 tons/hr- 1000/hr	Yes					2.0 to 2.5			
-3 addit. trans. units 3 tons/hr- 3000/hr	No	Complete	Jan-Feb 1967						
-1 tons/hr transp.	No	Complete	Fall 1967			1.0 to 1.5			
3-RETURN									
Pittsburg, CO (Rotary kiln incinerator)									
-Transportable rotary kiln incinerator 9000/hr.	No	complete third rep. approx. 60 months	Liquids, solids	kilo-1000, secondary contact, -6500.	approx-12 min.	10.0	None. Although ERM mobile incinerator permit status and burn data may be of some benefit.	None. Two Burn Data columns	This unit design is a scaled-up version of ERM's mobile unit, which RETURNED fabrication. The new design reflects experience gained in operation of the mobile unit. Fabrication of a unit is about to begin for operation experience.

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TEST	PLANNED			RECEIVABLE WASTE	OPERATING TEMPERATURE (°F)	CONVERSION RATE RETENTION TIME	GASOL. SOLIDS CONCL. (TON/HR) AT 20% WASTE	WASTE CONCL. TYPE/REMARKS	PERMIT STATUS PERMIT/COMPLIANCE	COMMENTS	
	EXISTING YEAR/NO	DATE OF COMPLETION PERIOD	PROCESS FACILITY								
6-EPH KIDNEY DECONTAMINATOR											
-Mobile rotary kiln incinerator-KIDNEY/AR.	Yes			liquids, solids	1100-1200 secondary coolant. -1200	gas-12 sec.	1.0	Decreased PCB and dioxin burn data.	National PCB and WED. Replan VII for dioxin. PCB has been delisted.	Capacity is not great enough to justify treating the Creek contaminant. The entire hardware is currently being upgraded to increase capacity and overall efficiency.	
7-REX											
Cincinnati, OH (Cincinnati Rotary Incinerator)											
-30% lower diameter 200% long pilot unit is operating at Billies, NJ	Yes			liquids, solids	1400 to 1700	solids- 15 to 20 minutes, gas-12 sec.	1.0 to 2.0	Billies has used the unit for test runs. Availability of this data is questionable.		The unit was designed and fabricated by ARMA. It was owned by Billies of NJ. REX are now the unit and plans to convert it to a mobile unit.	
-40% lower diameter 250% long unit is serving as a coal fired boiler in Ohio.	Yes			.	.	.		Test burns of chlorinated solvents co-fired with coal were conducted in the fall of 1985.			
-Additional units could be completed if demand is present.	No			Indefinite. Should run. 8/1/85	.	.					
8-EXISTING PLANS SYSTEMS											
Plans are Pyrolysis											
-One completed plant are while unit exists BRIGHT	Yes			liquid (pyrolysis) organic residue	2000	decomposition zone (a few thousands of a second).	solids-400 liquids-1 to 2.5 gal/min.	The unit has successfully burned carbon tetrachloride, ethyl ethyl ketone and PCBs in Canada. Results indicate 60-70% were achieved.	Compliance with existing requirements of EPCRA and RCRA is being reviewed by EPA Region 2 and KIDNEY.	KIDNEY will demonstrate the existing unit at Low Canal. It should be noted that present plans call for the unit to treat Low Canal leachate treatment plant sludge only.	
-Another plant are while unit planned for commercial use.	Yes		late 1985	.	.	.	solids-400 liq.- 2 gal/min.				
-Electric Pyrolysis				solids				Test burned surrogate materials in Reg. IV. Results are not yet available.		Similar to KIDNEY/ARMA. REX. Trying to upgrade to 20 tons/day.	

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TABLE A-2 PLANNED AND EXISTING TRANSPORTABLE THERMAL WEATHERING SYSTEMS

UNIT	EXISTING YEAR	PLANNED		OPERATING TEMPERATURE (°F)	OPERATING CAPACITY CUBIC FEET PER HOUR	EXTRA EQUIP. REQUIREMENTS	PERMIT STATUS		REMARKS
		DESIGN	PROG.				PERMIT/APPROVAL	STATUS	
9-DIGGING WEATHERING									
CASA, (2) High Temperature Fluid-Hall (HFD) Master Pyrolysis									
-12-inch cube solids unit is presently in storage.	No			liquids solids	4000	1.5 to 2.0	Six 9's with base-chloro- benzene. See also other HFD here data.		Other's HFD was designed and built by Shepard. Feed material cut to ground finely.
10-FULLER POWER CORP.									
Oriskany, NY (Heavy duty incinerator)									
-Transportable rotary kiln incinerators. -2 tons/hr. -4 tons/hr. -6 tons/hr. -Additional units available upon demand	No	complete		liquids solids	kiln- 1000 to 2000 second. combust. 2000 to 2500	gross 12 cm.			Fuller will not fabricate a unit unless a full-scale job is prepared. 6 to 10 cm. are required to fabricate.
11-IT CORP.									
Savannah, GA IT Corp. failed to respond to the questionnaire. They are, however, currently pursuing the potential for utilization of conventional incineration of liquids and solids at hazardous waste sites. These units will be transportable and have recently completed the detailed design stage. Fabrication of a unit is expected to be completed in 1987.									

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Another process which was not discussed in the CH2M HILL report is Shirco's infrared incineration system. In this process, hazardous material moves through an infrared furnace on a high temperature metal belt and is exposed to infrared heating elements. The waste is stirred at several points in the furnace to maximize process rates. The primary chamber is capable of attaining temperatures of 1850°F with 10-90 minute material residence times. The process residue is discharged through the furnace bottom into a hopper. The furnace gases enter a secondary chamber, (temperature = 2300°F, residence time = 2 seconds) prior to entering a venturi scrubber for air pollution control.

The second column indicates what stage of construction the unit is in, e.g., whether or not the unit exists and if it does not exist, the date(s) when the proprietor expects the design and/or fabrication to be complete.

The next three columns specify average operating conditions for the unit, and wastes which the unit is capable of treating. For comparison purposes, it should be noted that Federal regulations governing the incineration of PCBs (40 CFR 74), requires that PCBs be incinerated at 2200°F for two or more seconds in the secondary combustion chamber (or liquid injection unit).

The burn data column summarizes trial or test burns which have already been conducted or are scheduled to take place. The purpose of the burn is also indicated. Most of the burns were performed as part of a RCRA or Toxic Substances Control Act (TSCA) permit process. Results are provided in terms of the destruction and removal efficiencies for specified chemicals where this information was available. It should be noted that pentachlorophenol, octachlorodibenzodioxin, carbon tetrachloride and some isomers of PCB are considered harder to thermally destroy than tetrachlorodibenzodioxins. Hexachlorobenzene, trichlorobenzene and TCDD are comparable in terms of their resistance to thermal destruction. As the table indicates, results of tests performed with the units are quite good. These results complement those outlined above for dioxin test burns and indicate that thermal destruction is effective in treating and destroying hazardous materials. The permit status column lists any permits obtained (or applied for) by the proprietor; the date the permit was received; and the agency which reviewed the permit application and granted the permit.

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Several of the units will be capable of treating greater than 2.5 tons of sediment per hour. These feed rate figures are based on an operational efficiency of 75% of the design feed rate. Assuming a conservative conversion factor of 1.68 tons of sediment per cy sediment at 50% moisture, the 15,000 cy of creek sediments and approximately 25,000 cy of material which could potentially be generated as a result of the creek remediation could be destroyed in three years if a 2.5 ton per hour unit was operated 24 hours a day, seven days per week. A greater than five (5) tons per hour unit such as those currently fabricated or under fabrication by Shirco could process the creek sediments in less than half of that time. It is very important to note that the major time constraints would occur prior to full-scale operation of the unit (see Figure 3-1) and during inevitable "down time" periods.

The units described in Table A-2, which are capable of treating solids are also capable of treating liquids. These units could treat other miscellaneous wastes stored at Love Canal (see Table B-1) and potentially the spent activated carbon and leachate treatment plant sludge. However, since remediation of the creeks will result in the largest quantity of TCDD contaminated material, and since the sewer sediments are the most highly contaminated material to be stored on-site aside from the LTP sludge, this analysis is focusing upon destruction of the creek and sewer sediments.

Off-Site Thermal Destruction (Fixed Facility)

The finalized EPA dioxin regulations, effective July 15, 1985 require six 9's DRE. The regulations allow for interim status incinerators to incinerate dioxin waste if approved by EPA and if a successful test burn has been conducted on something more difficult to incinerate than dioxin. Fully permitted incinerators (those with RCRA Part B permits) must follow similar guidelines. No commercial incinerators have interim or fully permitted status for thermal destruction of dioxins.

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Certain polychlorinated biphenyls (PCBs), in addition to other various compounds, have been determined by EPA to be more difficult to destroy than 2,3,7,8-TCDD. Various thermal destruction facilities across the country have successfully destroyed PCBs in both liquid and solid form.

No facilities are fully permitted at this time to thermally destroy 2,3,7,8-TCDD, therefore, this section of the addendum will discuss available PCB permitted facilities that have expressed interest in accepting and thermally destroying 2,3,7,8-TCDD contaminated materials.

At the time of this report, the following five hazardous waste incineration facilities in the United State have USEPA Toxic Substances Control Act (TSCA) permits for the commercial incineration of PCB-contaminated waste:

- Energy System Inc. (ENSCO) - Arkansas
- General Electric Company - Massachusetts
- Pyrochem Company - Kansas
- Rollins Environmental Services Inc. - Texas
- SCA Chemical Services, Inc. (Div. of Chemical Waste Mangement) - Illinois

In addition to the above mentioned incinerator companies, an alternate thermal destruction facility is also TSCA permitted to commercially thermally destroy PCB-contaminated wastes:

- J.M. Huber Corp. - Texas

J.M. Huber has a TSCA permit for their fixed facility in Borger, Texas; however, they have stated they will not be accepting any toxic or hazardous waste for at least the next two years. This decision was based on market conditions, and also includes transportable units.

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The General Electric facility in Pittsfield, Massachusetts, is a liquid injection PCB incinerator with a capacity of approximately 2 gallons per minute. This facility only accepts liquids and was therefore not considered further. The remaining four facilities include ENSCO, Pyrochem, Rollins and SCA. To date, both ENSCO and SCA have expressed a willingness to consider accepting dioxin waste in the future. Their principal constraints have been public resistance to transport and incineration of dioxin waste material and undefined threshold concentrations. Rollins has indicated an interest in accepting the dioxin-contaminated materials, and has submitted tentative cost estimates and scheduling requirements for the destruction of the Love Canal sediments. Of the commercial firms mentioned above, only Rollins and ENSCO have applied for certification to treat dioxin wastes.

The following discussion is an updated version of the off-site commercial incineration section mentioned in Chapter 6 of the CH2M HILL Report:

Rollins

Rollins currently operates three commercial hazardous waste incineration facilities. Their locations are Deer Park, Texas; Bridgeport, New Jersey; and Baton Rouge, Louisiana. Although all three are of similar design and operate in the same mode (i.e. same kiln temperature and retention times), only the Deer Park facility is TSCA permitted to burn PCBs.

An application for test burn at the Baton Rouge Facility for PCBs was submitted in December 1984 and public hearings were conducted in early 1985. Due to public opposition, it was determined not to pursue PCB incineration at this facility at this time. The Bridgeport facility also attempted to conduct a trial burn in mid 1985; however, local opposition halted the effort.

Rollins' Deer Park facility appears to be capable of handling the Love Canal stream/sewer sediments. A test burn conducted at this facility demonstrated a DRE of six 9's with PCBs. As stated above, certain PCBs have been determined by EPA to be more difficult to destroy than dioxin. Rollins anticipates conducting a dioxin test burn at their Deer Park facility; however, they could not provide a schedule for the burn at this time. EPA Region VI will review the burn results and determine whether or not to approve incineration of dioxin at this

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facility. Rollins' facilities are also fully equipped with air pollution control systems (consisting of a packed scrubber and a jet particulate scrubber) and solids handling capability for feeding drums.

The current January 14, 1985 dioxin regulations require that any dioxin residue, except for soils that undergo six 9's thermal destruction, must be disposed of in a facility that can accept acutely hazardous waste. Rollins has submitted their RCRA Part B permit application (excluding dioxin) for their hazardous waste landfill and incinerator at Deer Park. Upon approval of these permits, Rollins then anticipates amending them to include dioxin.

Rollins management personnel have stated that they could plan to have the Deer Park facility available for the proposed incineration of Love Canal stream/sewer sediments if a timely marketing decision is made to accept the sediments. The incinerator will not likely require any capital improvements before accepting the sediments. If all the material is incinerated at one location, the incineration phase of the remedial action could be completed in approximately one year for 40,000 cy yards of sediments, provided the facility is 100 percent available for incineration of Love Canal material. Under actual conditions, however, Rollins' Deer Park facility would not be 100 percent available to incinerate Love Canal sediments. Rollins was not able to provide a realistic time schedule for treatment of the sediments; however, the time required to incinerate the 40,000 cy of sediments would be vastly increased. This factor could therefore potentially prohibit incineration of the Love Canal waste at the Rollins Deer Park facility.

Based on the fact that no off-site commercial facilities are currently permitted or certified to treat dioxin-contaminated wastes, off-site thermal destruction was not considered for detailed alternatives analysis.

SCA Chemical Services

SCA, a division of Chemical Waste Management, operates a commercial rotary kiln incineration facility in Chicago, Illinois. Although the facility is TSCA permitted to burn PCBs, Region V EPA requires "waste stream by waste stream" approval. Region V EPA has not granted approval of dioxin incineration. Before Chemical Waste Management could consider accepting the Love Canal stream/sewer sediments, they would need to give public notice, supply a detailed waste characteristic summary for EPA review,

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and conduct a trial burn of the sediments. Chemical Waste Management has recently indicated that they are not willing to accept any dioxin-contaminated waste from Love Canal at this time.

SCA intends to construct and operate a commercial hazardous waste thermal destruction unit at its Model City, New York facility. The unit will be capable of destroying both liquid and solid hazardous waste and is being designed to attain PCB destruction efficiencies (six 9's DRE). Initially, SCA intends to apply for a permit to treat only RCRA hazardous waste (excluding dioxin), however they could modify the permit to treat PCBs, should a sufficient market become available. The unit will have a capacity of approximately 100 million BTUs/hr., which is comparable to the size of their Chicago facility. A final design for this unit is expected to be complete in late 1987 and to SCA intends to apply for a RCRA permit in early 1988. Following review and approval of the permit, SCA anticipates the unit could be operating by mid 1989.

SCA is presently 75% complete with fabrication of a mobile pyrolysis unit that will be utilized to destroy liquid and solids PCBs at their Model City facility. Once the unit is fabricated SCA intends to conduct a trail burn and apply for a permit to destroy PCB-contaminated materials.

The ocean incineration vessels, Vulcanus I and II, owned by Chemical Waste Management, burn only liquid hazardous waste, and were therefore not considered further.

ENSCO

ENSCO, a division of Environmental Systems Company, operates a commercial rotary kiln incinerator in El Dorado, Arkansas. This facility is TSCA permitted to burn liquid and solid PCBs, and has a design capacity of 180 million BTUs/hr (3700 pounds/hr). ENSCO does not have any plans for treating dioxin waste at their facility at this time due to institutional and public restraints.

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PYROCHEM

Pyrochem Company operates a commercial slagging rotary kiln incinerator in Coffeville, Kansas. This facility is TCSA permitted to burn solid and liquid PCBs, and has a capacity of 50 million BTUs/hr. The process involves introducing a glass material into the kiln which ties up the residual ash. The resultant product is a glass-like slag material which is not delistable at this time. The residual is disposed of in a RCRA permitted landfill.

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APPENDIX B

OTHER OPERABLE UNITS

Although this FS addendum focuses solely on remediation of the sewers and creeks, there are a number of other portions of Love Canal currently under various stages of investigation or remediation. These other areas include Love Canal Proper, 93rd Street School, 102nd Street Outfall Delta Area, Cayuga Creek and the EDA home maintenance and buyout program. More detailed information on these areas is presented in this appendix.

LOVE CANAL PROPER

Love Canal Proper is comprised of a rectangular area of approximately 48.5 acres enclosed by a chain-link security fence. The area above the Canal is mounded in the center (584 feet above Mean Sea Level) and slopes gently in all directions to approximately 571 feet above MSL at the fencelines. The mounded portion represents a clay cover placed over the Canal in 1980 and also an extended cap consisting of silty sand protecting a synthetic membrane completed in November of 1984. The Love Canal administration building and wastewater treatment plant are centrally located on 97th Street near Wheatfield Avenue. All other structures and most of the trees within the fenced area have been removed. Building foundations have been filled and grass covers the soils throughout most of the site. Underground storm and sanitary sewer mains within the site boundary were severed and permanently closed with plugs in the fall and winter of 1982-83. Drums are staged on the west side, north of Reade Avenue, while a dewatering facility was erected on the central eastern side of the site boundary in 1986, to dewater sediments removed from EDA sewers. A decontamination drum storage facility will also be constructed in the area where the drums are currently staged. The facility will be used to manage the drums of waste generated during the normal operation of the site and will provide year round vehicle decontamination facilities.

Construction of an administration building was completed in December 1986. The new building is located within the fenceline, on the west side of the Canal, immediately west of the leachate treatment plant. The building supplements facilities provided by the leachate treatment

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93rd STREET SCHOOL

Previous testing at the 93rd Street School site has shown the presence of halogenated organics, BHC and dioxin in soil. Soil sampling completed at the site in September 1985 by the USEPA Field Investigation Team (FIT) indicated the presence of dioxin in three surface samples, up to a maximum of 1.2 parts per billion (ppb). No subsurface dioxin soil contamination was detected during this sampling event. It should be noted that the CDC level of concern for dioxin in residential soils in Times Beach Missouri was 1 ppb.

A consultant was recently contracted to conduct a Remedial Investigation/Feasibility Study (RI/FS) of the school grounds. RI/FS activities are currently being conducted and a long-term remedial action should be recommended by the fall of 1987.

102nd STREET OUTFALL DELTA AREA

The 1985 ROD called for a temporary berm to be constructed in the delta area to prevent the migration of contaminated sediments from this area. The design and location of this berm will be based upon sediment sampling previously performed by Malcolm Pirnie (1983 EID) and sampling currently being performed for the 102nd Street Landfill Remedial Investigation. Long-term remediation of the delta area is being coordinated with remediation of the 102nd Street Landfill. A decision on a schedule for implementation of this interim solution is expected by the fall of 1987.

EDA HOME MAINTENANCE AND BUYOUT

As required by SARA, funds have been made available for the maintenance of homes purchased by the Love Canal Area Revitalization Agency (LCARA). The homes will be maintained to prevent any further deterioration and to enhance the revitalization effort should a favorable habitability decision be made. In addition a \$2.5 million grant will be made to LCARA for the acquisition of properties which were not eligible for buyout under the 1978 and 1980 Federal Emergencies.

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REMEDIAL ACTION SCHEDULE

Table 2-1 outlines the schedule (through calendar year 1988) for the remedial work described above and in Section 2. Review of the table reveals that a good deal of remedial activity will be taking place at Love Canal through 1988. A key concern here is the date of completion of creek cleaning. The cleaning is expected to be completed in the 1989 construction season. The sediments will be mechanically excavated, and may have a high moisture content. The sediments may have to be dewatered to a limited extent prior to the closure of the facility, or the possible implementation of treatment/disposal methods discussed in this document.

Remedial work at the 93rd Street School is also of concern. The RI/FS and selected remedial action at the school must be coordinated with the design and remedy for the creek work to assure that the creek remedy is successfully completed without unnecessary delays. Preliminary investigations at the school indicate that remediation of the creeks can occur prior to remediation of the 93rd St. School. Depending upon the outcome of the FS, remedial action at the school may also require that a large quantity of material be treated or disposed.

As can be seen in Table B-1, large quantities of wastes require on-site storage as a result of remedial activities at Love Canal. More than 2400 drums containing inner sewer sediments, spent activated carbon and miscellaneous remedial wastes, are currently stored on-site. With the exception of drums of activated carbon, these drums will be placed in the containment facility. In addition, approximately 12,000 gallons of leachate treatment plant (LTP) sludge are stored on-site. Most of the wastes generated with the exception of some protective clothing stored in drums, are likely to be contaminated with 2,3,7,8 TCDD. The viability of thermally treating the LTP sludge with a plasma arc unit is currently being evaluated.

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TABLE B-1

Love Canal Remediation*Projected Waste Accumulation (Approximate Values)

	LTP Sludge	Drums presently stored	Sewers	Activated Carbon	Routine Site Remediation/ Maintenance	Creeks Black & Bergholtz.
Current Inventory	12,000 gallons	1,700 drums (250cy)	400-500cy sediment	700 drums (100cy)	Miscellaneous: drill tailings; clothing; decon materials etc.	
1987						
Sum	+ 1200 gal			+240 drums (50cy)	+100 drums (25cy)	
Fall						
Win						
1988						
Spr	+ 1200 gal			+ 240 drums	+100 drums per year of operation	15,000cy creek beds and banks, 6,000cy
Sum	per year of operation			per year of operation		6,000cy haul roads; 7,500cy basement rubble; 4,000cy miscellaneous
Fall						

* It should be noted that remediation of the 93rd St. School scheduled for 1988 could result in a need to store/treat a large quantity of waste.

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Approximately fifteen thousand cubic yards of sediment is scheduled to be removed from Black and Bergholtz creeks in 1988-89. Up to an additional twenty five thousand cy may be generated as a result of the creek cleaning effort. This material might be generated from potentially contaminated haul roads placed in the creek and from potentially contaminated house debris from ring 2 homes which must be excavated for construction of the interim containment facility.

Remediation of hot spots in Cayuga Creek may also be necessary in the future. Composite sampling of cross-sections of Cayuga Creek sediments for dioxin contamination was performed in June 1986. Two composite samples collected from cross sections of creek bed directly across from two storm sewer outfalls had concentrations of 2,3,7,8 -TCDD above 1 ppb.

It has been determined that additional samples will be collected in the outfall areas, and that fish will also be collected and analyzed for dioxin. If results of the additional sampling effort indicate that excavation of the Cayuga Creek sediments in the outfall area is necessary, a separate ROD would have to be signed approving excavation of these sediments.

In addition, final remedies for the 93rd Street School and the 102nd Street Outfall have not yet been determined. It is possible that remedial activities at these locations will also result in a large quantity of waste that will need to be treated/stored. As noted above, remediation at the Outfall will be coordinated with remediation at the 102nd Street Landfill. It is possible that the Outfall remediation will be performed as part of the 102nd Street remediation, in which case, treatment/storage of these wastes would not impact the Love Canal remedial program.

Routine operation and maintenance of the leachate treatment plant will continue to result in the generation of approximately 1200 gallons of LTP sludge and 200 drums of spent activated carbon and 100 drums or less of protective clothing and equipment annually.

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